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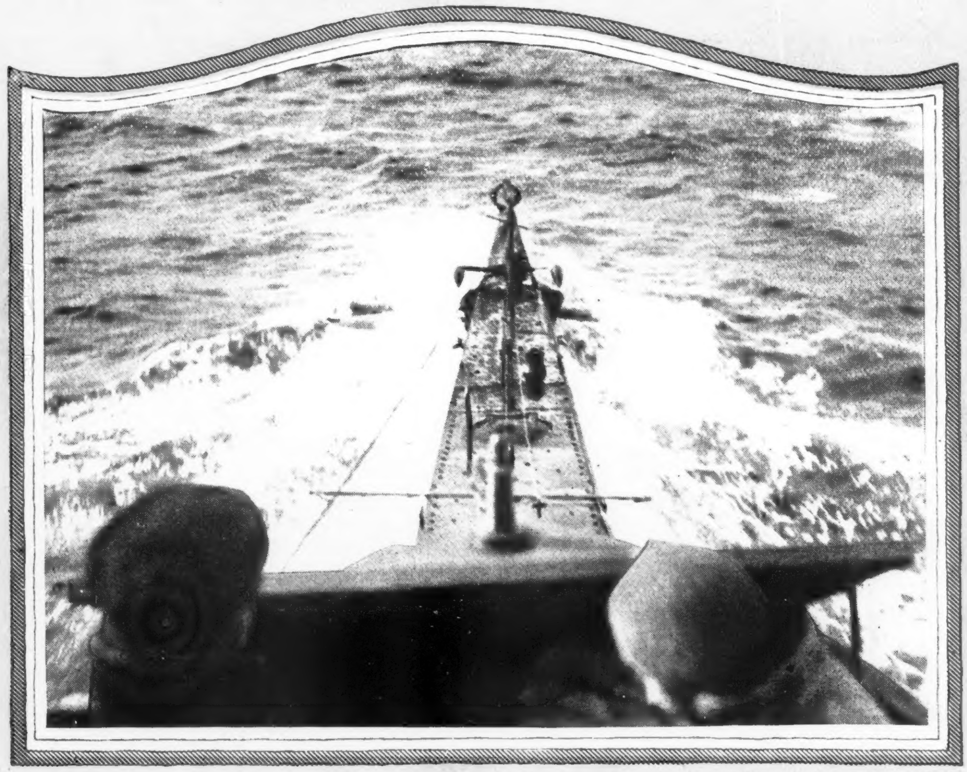

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UNCLE SAM'S LATEST SUBMARINE ON TRIAL RUN—SEE LEADING ARTICLE

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Compressed Air Magazine

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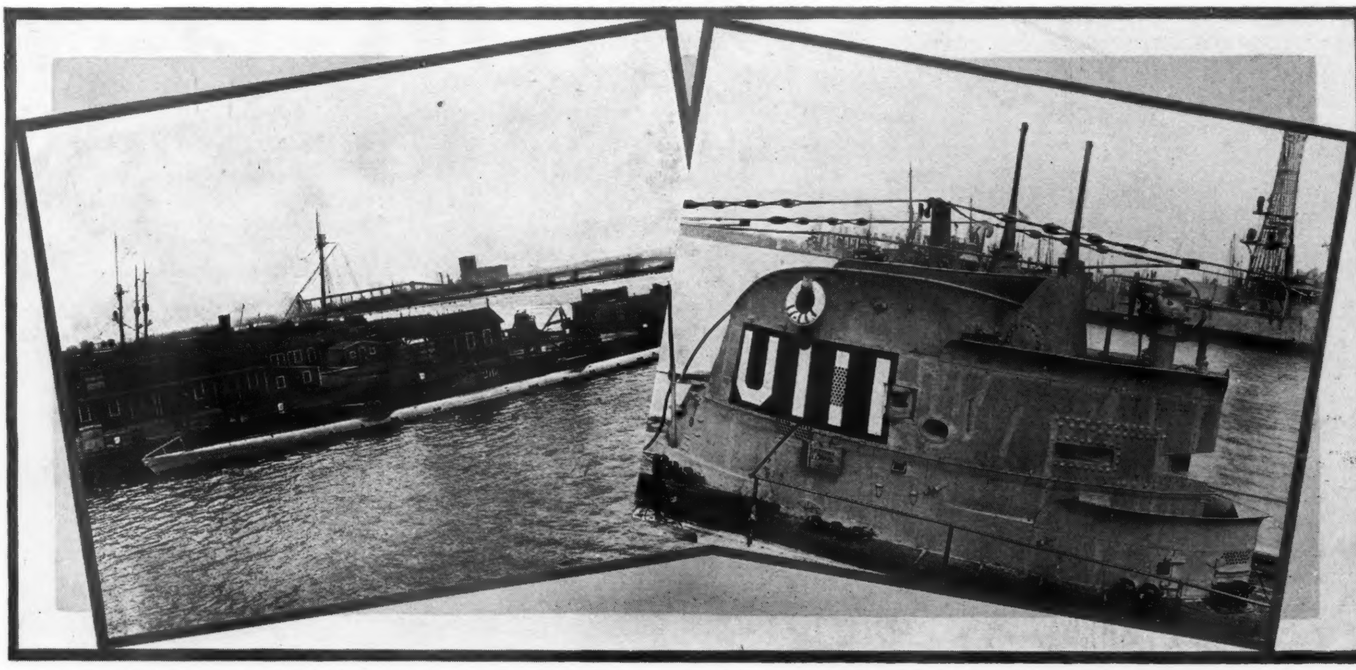
VOL. XXV, NO. VII JULY, 1920

The Uses of Compressed Air in the Modern Submarine

Supply of Air Necessary for Breathing, Ejecting Torpedoes and Blowing Ballast Tanks is Stored in Flasks at 2,500-lb. Pressure

By Capt. Yates Stirling, Jr., U. S. N.

Photographs made for Compressed Air Magazine Illustration Service



The illustration on the left shows U-III. German Submarine, mounting two 5-inch guns. Saw teeth in bow for net cutting. On the right is shown the Bridge of the U-III, together with periscopes of the housing type and steering wheel.

THE CONCEPTION of a vessel to travel underwater dates back several centuries. Fulton, the builder of the first American steamboat, in the latter part of the eighteenth century proposed to build a submarine for the French Government, but the French minister of marine declared, in declining the offer, that it would be dishonorable to utilize such a vessel against the warships of an honorable enemy. Submarines, called "Davids," were used in our own civil war. They were propelled by man power and succeeded mostly in drowning their daring crews.

The modern submarine became possible only after the successful development of the Diesel engine and the electric storage battery. The Diesel engine, using heavy oil is the submarine's main source of power. Two engines are installed. They drive the propeller shafts when the submarine travels on the surface. Through electric motors acting as generators the Diesel engines charge the storage batteries. The latter supply current to the motors which then drive the propeller shafts when the submarine travels beneath the surface.

For the reason that the Diesel engines in operation use great quantities of air at high pressure and extremely high temperature, and as it is impossible to carry air for this purpose, the oil engines cannot be run while the vessel is submerged but only when the boat is open to the atmosphere; that is when in surface trim or awash. For underwater propulsion therefore a secondary means has been provided: the storage battery and motors. The shafting of a submarine runs from engine to propeller. The motor is on this shaft, and geared to the shaft are the big ballast pumps, the engine air compressor supplying air to engines, and in some cases high pressure air compressors for charging air flasks. To enable both the engine and the motor to drive independently the propeller shaft and also to enable the engine to drive the motor as an electric generator to charge the storage batteries, two couplings are provided. The engine coupling joins the engine shaft to the motor shaft and the motor coupling joins the motor shaft to the propeller shaft. Both couplings being "in" the engine drives the propeller shaft through the motor shaft. With engine coupling "out," the motor can drive the propeller shaft. With engine coupling "in" and motor coupling "out," the engine drives motor for charging batteries.

The Diesel engine, the storage battery and the motors are all highly important factors in the operation of a modern submarine, but the marvelous agility, formidableness and safety of this type of warship could not have been achieved without the aid of compressed air.

Fritz, entertaining visitors.

Fritz at sea, looking for a prize.

The once proud naval flag of Germany.

The compressed air system of a submarine consists of air compressors, air flasks, storage tanks and piping for high pressure air and low pressure air. Air reducing valves are fitted in air lines where required to reduce the pressure of air from flask pressure, 2,500 pounds per square inch to the pressure required for any special purpose.

The general practice is to drive the high pressure air compressors from the main motor shafts. Motor driven air compressors are used, notably in German submarines. A submarine when running on top of the water is maneuvered like any other type of surface ship. But, in less than sixty seconds after the commanding officer has given the order to submerge, the submarine, unlike its sisters of the surface, can be under water completely and running silently on its motors and with freedom to steer in two planes horizontal and vertical, instead of only one.

As regards the hull construction of submarines, two distinct types have been developed. The single hull type is the older one. The double hull type, as exemplified by the German U-boats, was designed in order to gain high surface speed on a moderate length.

A single hull type is exemplified in our American Holland submarines built by the Submarine Boat Company. Their hull is in the shape of a spindle, largest diameter in the middle, narrowing toward the ends. Water ballast for submerging is admitted into tanks contained within the spindle hull.

When it became desirable to obtain high surface speed without unduly increasing the length of the vessel, more surface buoyancy had to be provided. This was accomplished from the older designs, by working a hull outside of the central spindle hull. In some cases the outer hull was only partial while in others it ran the entire length of the vessel. The outer hull was shaped to give the vessel the necessary fineness for high surface speed. A double hull submarine resembles a destroyer more than it does a single hull submarine; in fact, it has been called a destroyer-submarine. It combines the characteristic of high surface speed and the ability to disappear from view. In this form the submarine has become a very formidable warship and it is not yet at the top of the cycle of evolution.

The single hull type is at its best when submerged. It cannot be driven at high speed on the surface. The double hull type is at its best on the surface. It is inferior to the single hull vessel when submerged.

The double hull type carries both water ballast and fuel oil in tanks located between the outer and inner hull plating. Both types carry auxiliary and adjusting tanks inside the spindle, and the single hull type carries its ballast tanks within the spindle. The spindle hull is designed to withstand a pressure corresponding to a depth of from 200 to 300 feet. The outer hull of the double hull type is thin and can stand very little pressure.

The double hull type is fitted with engines of large horsepower to give it great surface speed. Some nations, notably Great Britain, have built vessels of this type propelled by

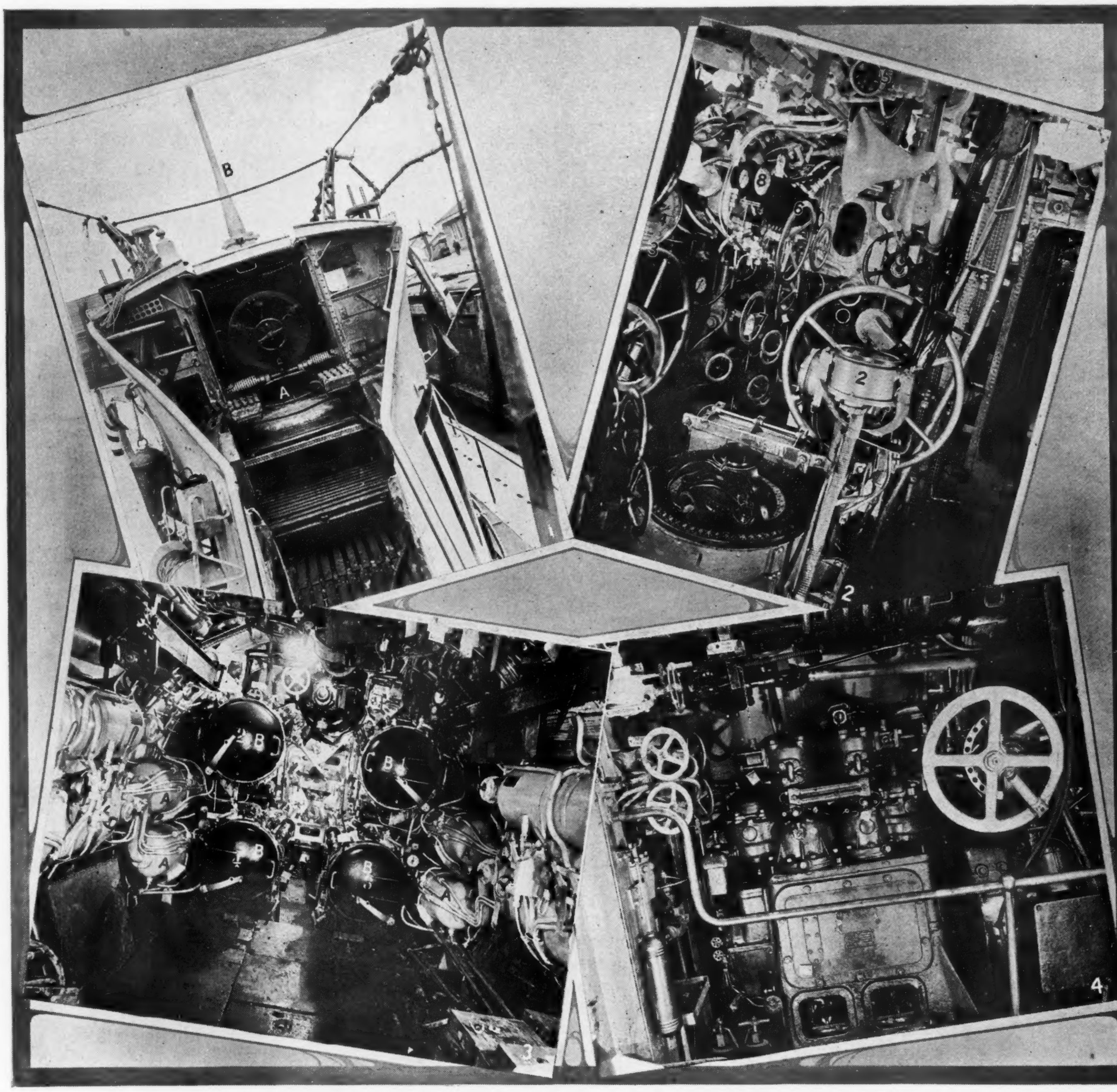


Fig. 1.—Inside view of bridge, showing hatch leading to conning tower and periscope. Fig. 2.—The operating room of the U B 148. No. 1 shows a Gyro compass. No. 2. A Gyro repeater. No. 3. Diving wheel. No. 4. Depth gauge. No. 5 Master air vent. No. 6. Master air valve for blowing. No. 7. Air manifold. No. 8. Air gauges. Fig. 3.—The Torpedo room, U B 148. (a) Air impulse tanks. (b) Torpedo tubes. Fig. 4.—A four-stage compresor in pump room of German submarine, U B 148. Capacity about 15 cu. ft. per hour, at 2500 pounds.

steam turbine engines. This class of submarine has made about 25 knots on the surface. In addition to the steam turbine installation a low power Diesel engine is supplied. This engine provides a means of economizing fuel when desiring to run at slow speeds on patrol.

In submerging a submarine, sea water is admitted through large Kingston valves to the ballast tanks. In the latest double hull type there are no Kingston valves in outer tanks but water comes in through big steel doors that open inwards. The best practice, as developed primarily by the Germans, is to have sea valves always open so that there can be no undue pressure on the thin outer hull plating. Then when desiring to submerge a master valve controlling all the air vents in the tanks is opened and water rushes in, forcing the air out. As the submarine sinks lower in the water the pressure of the water increases until the tanks are full. Then the vents can be closed. The valves are located at the lowest part in the tanks while the air vents are at the top of the tanks. After ballast tanks are full the submarine is in the "awash" condition. It still floats.

To completely submerge, water is admitted into the auxiliary tank. This tank is built to stand the pressure of 200 to 300 feet depth of water. The main ballast tanks are in volume very nearly equal to the reserve of buoyancy of the submarine. The auxiliary ballast tank is for the purpose of compensating for consumable stores or loss of weight of vessel by any cause. The auxiliary tank then actually submerges the submarine. The adjusting tank is of a standard size and is used to measure water going into auxiliary tank or trimming tanks to obtain accurate results in trimming down. A submarine captain usually prefers to operate his vessel with a small amount of buoyancy, say half a ton.

It might be well to bear in mind the close analogy between a submarine and an airship. An airship of the dirigible type with its engines stopped, if it displaces a greater weight of air than its own weight, will rise and fall if it displaces less weight. A submarine likewise, if it displaces a greater weight of water than its own weight will rise and fall if it displaces a less weight. Air varies in density while water is incompressible. An airship displacing a greater weight of air will rise until at a certain altitude it will displace an equal weight of air when further motion upwards will stop. Once a submarine has been submerged with definite buoyancy, that is dis-

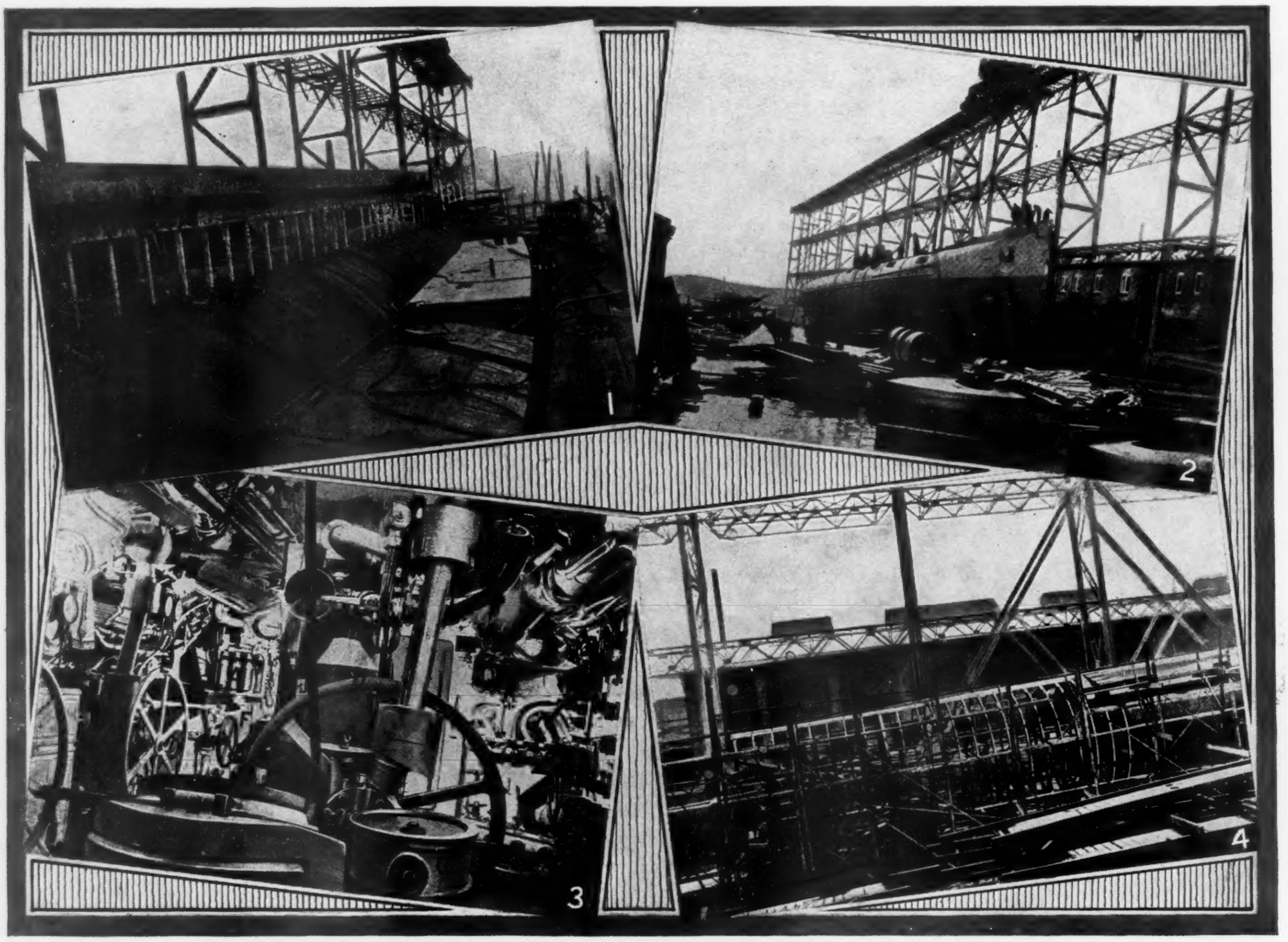


Fig. 1—German submarine, "Deutschland" under construction. The small number indicates (1) top of oil and ballast tanks, outer hull and No. 2 shows the inner hull. Fig. 2.—"Deutschland" typ3 ready for launching. Fig. 3.—Central operating room of "Deutschland." a. Draeger system of air purification; b. Gyro compass; c. Gyro repeater; d. hand wheel for steering; e. diving steering wheel; f. master air valve for blowing tanks. Fig. 4.—German submarine under construction; showing framing of inner (spindle) hull.

placing a certain weight of water more than its own weight, it retains the same buoyancy whether near the surface or at a depth of three hundred feet, the maximum limit of submergence. Once given buoyancy it always has the tendency to rise to the surface. Diving rudders or hydroplanes are employed to keep a submarine with buoyancy under water. These rudders are horizontal, and by resisting the water as the submarine moves through it, cause the nose of the vessel to dip or rise. Any desired depth can thus be maintained.

A submarine with its ballast tanks full of water sinks low in the water and is in its longitudinal stability very similar to a board ballanced at some point between its two ends. If the weight on each side of the fulcrum, or center of gravity, is the same the vessel will lie horizontal. If not, the heavier side will sink until equilibrium is restored. To obtain equilibrium on a level keel, tanks called trimming tanks are installed in the extreme bow and stern. By adding or subtracting water into these tanks an even keel can be maintained. In operation a submarine captain will endeavor to trim his vessel so that the bow has a tendency to rise. In other words with the bow lighter than the stern.

When the submarine is under water the only means of vision is through periscopes. The vessel must be near the surface in order to use that optical instrument. It need however only expose a few feet of the periscope to view, and then only for a few seconds; the hull of the vessel meanwhile being some twenty odd feet beneath the surface.

The first operation in submerging is to make certain that all openings in the hull that might admit water to the inside of the boat are closed. This includes hatches, scuttles, engine exhausts, ventilator openings, etc. The engines are stopped and uncoupled from the motor shafts. Then by means of big hand wheels in the operating and other compartments adjoining, the Kingston valves and air vents are opened and water allowed to fill the ballast tanks. In the latest practice the seavalves are left habitually open, in which case the air vents only need be opened. The vessel is meanwhile kept level by adding or subtracting water into trimming tanks. The motor is started, driving the propeller shafts; power being furnished by the storage batteries. After this the auxiliary tank is flooded until the diving rudders will easily overcome the tendency of the vessel to remain at the surface. The men at the diving rudders have their eye gauges graduated in feet to guide them in keeping the vessel at whatever depth the captain wishes to maintain. Once the ship is submerged the importance of compressed air is apparent. No submarine officer in time of peace would wish to submerge with his air flasks empty.

Air compressors such as are used in submarines are manufactured by a number of well known firms. Among these are: The Ingersoll-Rand Company, the Platt Iron Works, the New London Ship and Engine Company, and the Norwalk Company.

The first stage of compression of a submarine compressor brings the air from atmosphere to about twenty pounds, the second to 120 pounds, the third to 600 pounds and the fourth to 2,500 pounds per square inch. The above figures are only approximately accurate. High pressure air is stored in air flasks made of the highest quality of steel, usually chrome-vanadium. The flasks are subjected to a test pressure of 5,000 pounds in manufacture, or double the working pressure. The air compressors of an up to date submarine are capable of delivering each as high as 25 cubic feet of air at 2,500 pounds per hour. The largest vessels such as the cruiser type used by Germany have an air flask capacity of about 300 cubic feet. Air compressors can be operated only while the vessel is on the surface. They obtain their power either direct from the engine or from a motor. It requires about ten hours to charge all air flasks if empty.

It can be readily understood that, as much time is required to store air a submarine cap-

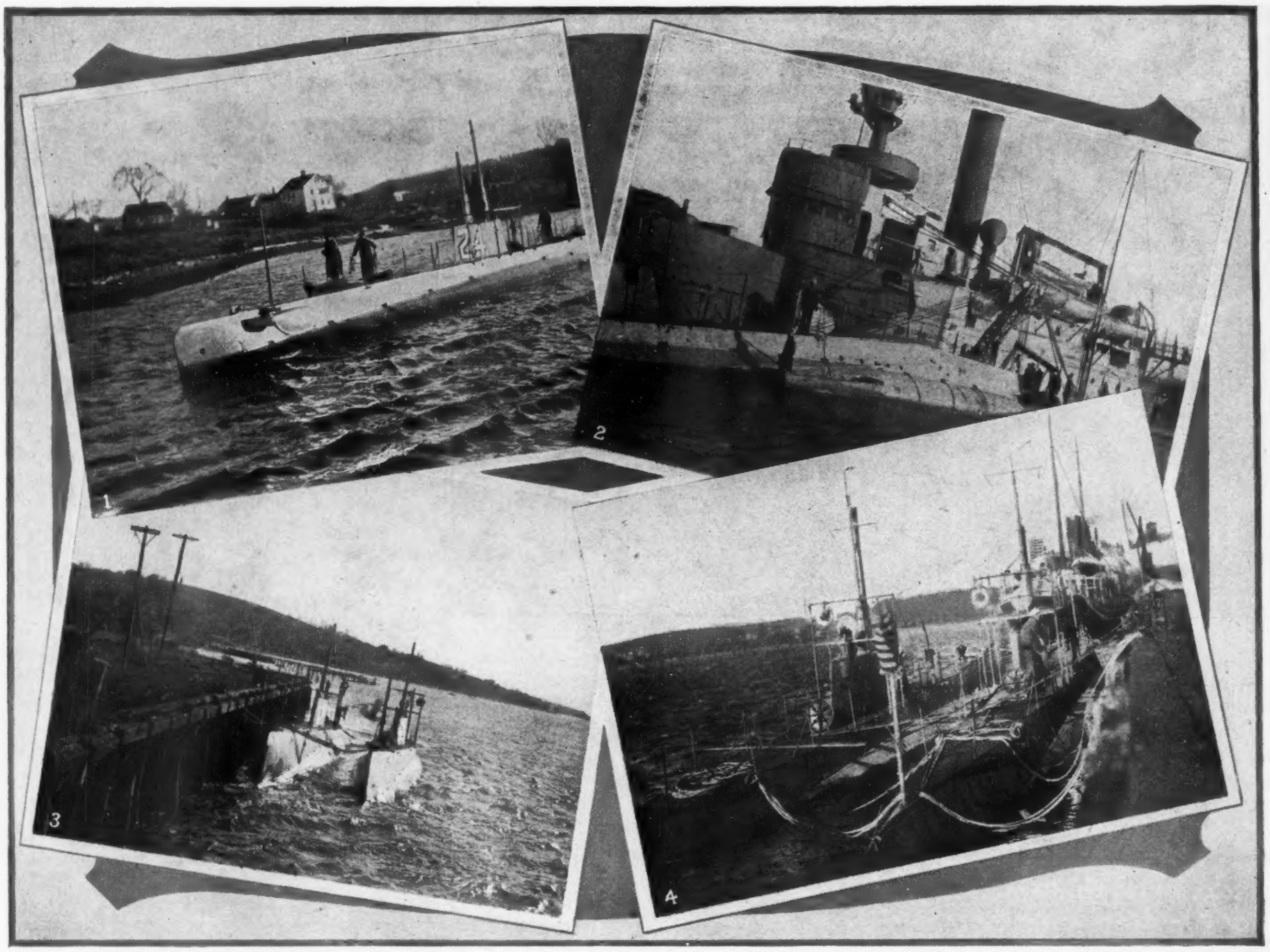


Fig. 1.—A Small United States submarine. Fig. 2.—Repairing a submarine's propeller. Tail being lifted by a derrick on board a tender ship. Fig. 3.—Two tiny submarines, a type now obsolete. Fig. 4.—A close up view of small submarines; useful only for coastal work.

tain will be loath to use air except when absolutely necessary and even then sparingly. He will never waste it, knowing as he does that in an emergency it may be the one means of saving the lives of his crew.

The high pressure air flasks are variously located; sometimes within the spindle hull and in other cases outside. The flasks are piped to air manifolds operated from within the vessel. Reducing valves are fitted in high pressure air lines in order to reduce the flask pressure to the average working pressure desired; further reduction can be accomplished at the air manifold by throttling. Air piping is run to all ballast tanks, auxiliary tanks, adjusting tanks, trimming tanks and in many cases to fuel tanks. By means of compressed air any tank can be freed of liquid. Water can be blown from any interior tank to another and fuel oil can be blown overboard or changed from one fuel tank to another to suit the requirements of trim. In most cases a pump may be used instead of air.

The above elementary description of the operation of a submarine has been given for the purpose of paving the way to a clear understanding of the various uses of compressed air.

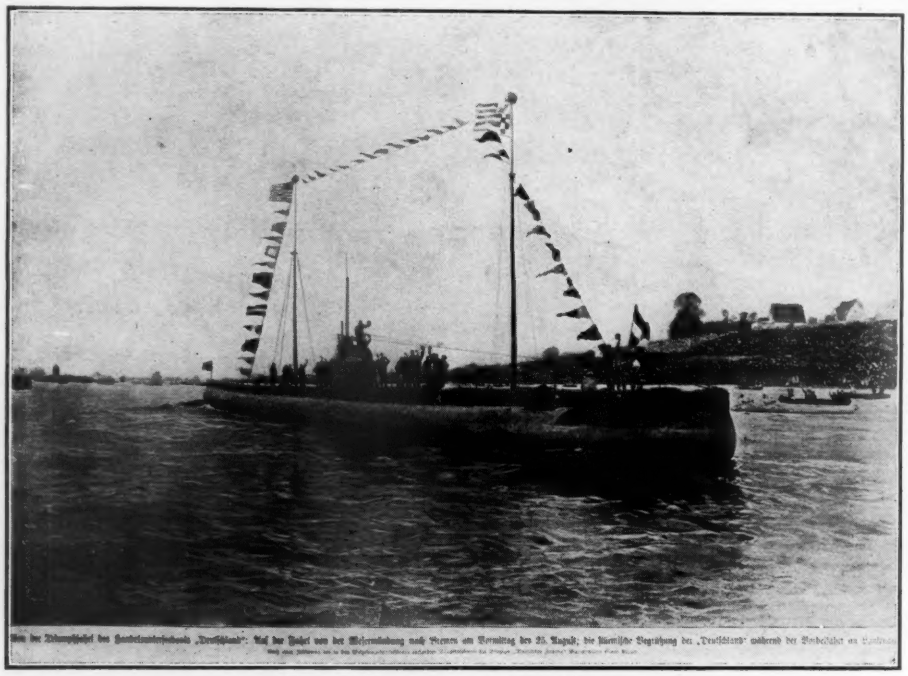
After a submarine submerges the air within the vessel remains at atmospheric pressure, unless, as in some types, the tanks when flooded are vented inside the boat. In that case the rise in air pressure can be relieved through vents in the ship, provided it is yet on the surface. After the vessel has remained submerged for several hours the air naturally becomes foul. The carbon dioxide exhaled by the crew, fumes from the acid of the storage batteries, gases from other causes, such as cooking, contaminate the air. It is necessary therefore to provide some method of air purification in order to permit the vessel to remain under water for long periods of time. In war this is most important for when hunted by destroyers the submarine's ability to remain beneath the surface is its main hope of safety. Probably the best known method of air purification is the German Draeger system. In this the foul air is forced through cylinders filled with crystals of potassium hydroxide which absorbs the CO_2 and other impurities. Then the purified air passes through water bottles where it is washed, and after that sufficient oxygen is added from compressed oxygen flasks. This reiuvenated air is now carried by pipes to all parts of the boat and blown in as fresh air. Compressed air can be used to replace oxygen, but a larger volume is needed.

Torpedoes are run by compressed air and they are the principal weapon of the submarine. Compressed air at full pressure is stored in a flask or tank inside the torpedo. These flasks are charged direct from the air compressors. This high pressure air inside the torpedo is reduced by means of reducing valves to the working pressure of the torpedo's turbine engine. Air is the motive power of the weapon.

At each torpedo tube are air tanks with capacity sufficient to drive a torpedo from its tube. The pressure in these impulse tanks is reduced by valves considerably below flask pressure. After a torpedo is ready for launching, all adjustments having been made, it is loaded into a tube. The tube has a cap on the water end and a door on the inside. When ready to fire a shot, the door is closed, the tube flooded and cap opened. Then to fire the torpedo from the tube a key is pressed which opens a valve and admits the impulse air to the tube in rear of the torpedo. The weapon and water are thus blown out. The torpedo after leaving the tube uses its own power to continue its progress in the direction pointed.

In the largest submarines compressed air is used to operate the heavy clutches which connect the engine shaft to the motor shaft and motor shaft to the propeller shaft. Hand gear also is fitted.

The most important use of compressed air is that of blowing tanks. Ordinarily a submarine captain when he wishes to bring his vessel from submerged condition to the awash condition or even to surface trim, first blows



"Deutschland" in surface trim.

with air the water from the auxiliary tank located within the spindle hull. These tanks in the largest submarine hold not over 40 tons of water; in the smaller vessels they hold less than fifteen tons. Blowing out this weight of ballast causes the boat to rise to the awash condition. If air at the same time has been admitted to the ballast tanks, then the submarine will rise to surface trim. If the ballast tanks have not been blown, then the next step is to throw in the clutches to the big plunger pumps and with engines or motors pump out the water from the ballast tanks.

The tanks located within the hull; that is to say, the auxiliary and adjusting are built strong enough to withstand considerable pressure. They are tested usually to a pressure corresponding to 300 feet submergence or about 150 pounds per square inch.

In those German submarines, fitted with big flapper valves instead of Kingstons, when the auxiliary tank is blown to bring the vessel to the surface, the master air valve is opened and compressed air at about 100 pounds is admitted to the top of all ballast tanks. Enough water is expelled to form an air body which, as the submarine rises acts upon a rapidly decreasing head of water and finally forces out all the water, filling the tanks with air at sufficient pressure to prevent the tanks from again flooding until the air vents are opened. In this way the pressure on each side of the thin outside plating is maintained equal.

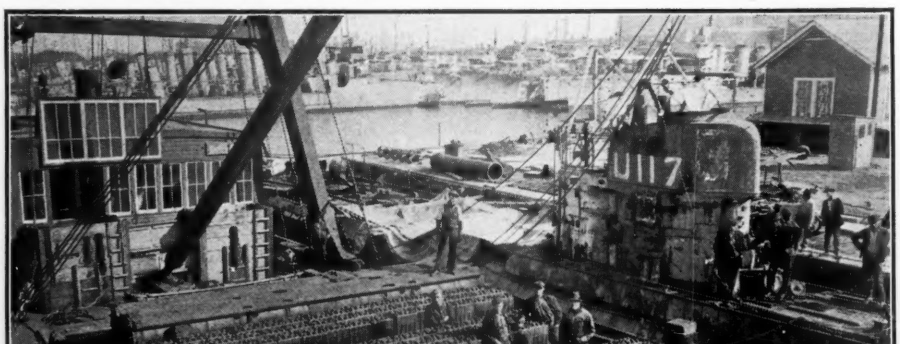
The air for blowing these tanks runs through heavy drawn copper pipes and reducing valves to air manifolds. Each tank has an air connection through the manifold, fitted with a sight gauge, a valve and pressure gauge. The operator at the manifold must note the pressure of the water in a tank due to the depth of the vessel and then use air at sufficient pressure to expel it. Freeing tanks by compressed air is a very quick and certain method. Pumping is a long tedious process. The German submarines have a low pressure air compressor, or in fact an air pump which is operated after the conning tower is out of water. This pump forces air at about eight pounds pressure into the ballast tanks and frees them of water in a very few minutes. Our submarine officers saw the German U-boats come up out of the deep, their decks high out of water, almost immediately they appeared, and begin shooting with their deck guns. In American submarines with which our people were familiar this could only be done with an extravagant expenditure of precious air, for to pump these big tanks dry with the slow plunger type pump then provided took the better part of an hour. It was found out later that the secret was in this air pump, which in its operation was almost as quick in freeing the tanks as using high pressure air and did not take a single pound from the air flasks.

The Germans also developed a motor driven pump with a water capacity of eight tons a minute. This pump could be used only in pumping auxiliary, adjusting and trimming tanks and was never used on the ballast tanks. The reason for this will suggest itself when it is remembered that the ballast tanks in the double hull type are not built to withstand pressure, and to pump a ballast tank when the vessel is submerged would put the tank under pressure at once. The above pump is used after submerging when it is wished to expel small quantities of water from the auxiliary or a trimming tank.

In freeing their ballast tanks, having a capacity of from 400 to 600 tons of water, either high pressure air was used or else the captain waited until he had broken surface and could use the air pump.

The most vital use for compressed air is when a submarine has gotten out of control and is sinking rapidly in deep water. Then high pressure air acting instantaneously is urgently needed. Weight must be dropped quickly to arrest this mass of steel hurtling downwards, gathering momentum as it goes.

Using air to blow tanks naturally in time exhausts the supply in the flasks, when the submarine must come to the surface to recharge; and to refill all flasks, if empty, requires about ten hours, less if both air compressors are used. This is the main reason why air is not used when a pump can be used with safety. A submarine operating among enemy surface warships may find but small opportunity of remaining on the surface to charge air flasks or storage batteries. The latter are the primary source of power when submerged. Charging



Storage Batteries removed from German Submarines.

air flasks and storage batteries is done whenever the vessel is on the surface in order to keep them at all times full.

There is a safety device usually installed in submarines: it is called the automatic blow valve. It can be set at a pressure corresponding to any desired depth, and should the vessel reach that depth the valve automatically opens and admits high pressure air to the ballast tanks, which quickly brings the submarine to the surface.

After blowing a tank completely the Kingston valve is closed. These are ordinary screw down valves, worked from the central operating compartment. This leaves the tank full of air at small pressure, depending upon the initial pressure used and the amount of high pressure air admitted to the tank. The next thing to do therefore is to open the air vent and let the air escape.

Lest the reader has not quite understood the German system a few paragraphs will be devoted to that system.

The Germans built nothing but double hull vessels. The big ballast tanks, located between the two hulls, are not pressure tight and therefore great care had to be exercised to see that they were never subjected to more than a few pounds pressure. The auxiliary and adjusting tanks, located inside the spindle hull or inner hull are strong tanks, capable of withstanding as high as 150 pounds without injury. The latter tanks are fitted with screw down Kingston valves. These tanks can be both blown and pumped. The ballast tanks are fitted with a large flat valve, hinged and opening inwards. These tanks can not be pumped, they must be blown. Let us take a German submarine submerged at say a hundred feet and bring it to the surface. The first operation is to put high pressure (100 pounds) into the auxiliary tank and through the master air valve admit high pressure air into the ballast tanks. The air valve to the auxiliary is kept open until that tank is free of water, when the Kingston valve is closed and the tank vented. The air valve to the ballast tanks on the other hand is opened only long enough to give a jolt to the water and then is closed. As the vessel rises to the surface the air admitted to the ballast tanks expands as the water pressure decreases and nearly clears the tank of water. When the submarine breaks surface the conning tower hatch or a ventilator duct can be opened, admitting atmospheric air to the boat. Then the low pressure air compressor or air pump can be started and the remaining air blown out and the valves of the ballast tanks closed. This low pressure air compressor is really a centrifugal blower of considerable power and clears the tanks in but a few minutes.

When there is a likelihood of submerging again soon, the Kingston or flat valves are left open in the ballast tanks and the vents closed. Then if it is desired to submerge all that is necessary is to open the master vent and the water will at once flood the tanks. The auxiliary is operated differently because that tank is never more than partially filled when the vessel is under; it is used to take care of the loss of weight of the submarine due to consumable stores, torpedoes, mines, etc.

Mention has been made of the adjusting tank. It is a small interior tank, holding an exact amount of water, say one ton. It is used as a measuring tank when putting in or taking out water from the auxiliary tank.

Air is used to blow water from one trimming tank to another, also to blow the water in a torpedo tube after the torpedo has been fired and into a trimming tank to compensate for the weight of the weapon.

While using compressed air for discharging water from tanks that are only partially filled, such as the auxiliary tank, great care must be used to have sufficient air pressure in the tank before the Kingston valve is opened; otherwise the pressure of the water will force water into the tank and may cause the boat to suddenly sink to the bottom. This has happened often to submarines of our navy, but fortunately always in shallow water.

In the event that a submarine is seriously damaged and on the bottom at a depth where the pressure is not great enough to crush it, there is provided an escape lock. The lock has two doors, one opening into the boat and the other into the water. A man enters the lock and the door closes. Then he opens an air valve admitting air to the lock. When the air in the lock is equal or greater than outside, the other door is opened and the man swims to the surface. The outer door is closed from within the boat, the water in the lock is drained into the bilge, and the lock is ready for use again.

In some submarines a diving compartment was fitted. It was an ordinary air lock with two doors; the one opening into the water opened down. In the escape lock the door opened up. In the diving compartment are air hose connections for the diver, who dons a suit and walks along the bottom. It has been claimed that by this method cables can be found and cut and also mines can be severed from their moorings.

The vital necessity of retaining air flasks full of air to be used in case the inner hull is damaged or in case the boat gets out of control, caused the Germans to look to the perfection of their ballast pumping system. Ordinarily with effective pumps capable of handling quickly large quantities of water against considerable pressure, high pressure air need not be used to free auxiliary tank or ballast tank. The main pumps used by the German U-boats could pump eight tons of water per minute against a head of 300 feet depth. That means that the pump could force water out of a tank against an outside pressure of 150 pounds.

In addition to all other means of freeing tanks of water, there yet remains the hand pumps. These are slow, but in the event that the air flasks are empty and the storage batteries run down, it may be the only means to safety.

There is a story in the American navy of a submarine that went to the bottom out of control in 150 feet of water. The Captain tried to blow the tanks with compressed air, but the vents leaked and no water was blown, the air all escaping through the vents. The motor driven pumps would not operate, the battery was nearly run down. The vessel was fitted with hand pumps, but they had never been used. The attempts to run the motor pumps used all the remaining juice in the battery; lights went dim and ventilating fans stopped. The hand pumps were manned. They were capable of only a few gallons a minute. The submarine was held firmly in the sticky ocean bed. The anxious crew watched the depth gauges. For hours, or it seemed so, for no log was kept, the gauge stood at 157 feet. Meanwhile leaks developed in the hull, around rivets and seams. No one could even guess if more water was being pumped out than leaked in. If the water was gaining on the pumps the boat was lost, and there was no air in the flasks to use the escape lock. When the air in the boat was so foul that men sank overcome in their tracks, there was seen a slight tremor of the depth dial. Then after a few minutes it registered a few feet less depth and then with a rush that was startling the boat fairly jumped to the surface.

The modern submarine is a formidable weapon. It has shaken to its foundation the former security of the big surface ship. All who crossed the ocean during the war, while the U-boats were operating, will testify to their moral effect. Battleships and cruisers did not sail out to sea with the same proud defiance as of yore. All eyes were ever on the watch less a submarine sneak near enough to launch a torpedo.

The submarine has given the term, "the command of the sea" a new significance. No nation will now be able to have free command of the sea as long as its enemy keeps a formidable submarine fleet.

And yet the submarine is not a super-ship; it can not perform the miracles claimed for it by the unenlightened few. It is a marvelous thing, but it has its limitations. Space does not permit me to say more.

In 1914 the United States navy seemed to put its faith in small submarines. Since that date much water has run under the bridge. Ideas have changed. The faith in the small type has been shaken. It is realized that the submarine is susceptible of great development in both size and fighting power and vessels are being built to satisfy those beliefs.

PREHEATER REQUIREMENTS FOR THERMIT WELDING

Recent tests made by the Metal & Thermit Corporation to determine the proper amount of air required for special thermit welding gasoline and compressed air preheaters show that 25 pounds per square inch seems to be a practical minimum for operating preheaters. At this pressure, a single burner preheater requires approximately 25 cubic feet of free air per minute and a double burner preheater approximately 50 cubic feet. For very large welds, where the walls of the molds are thick and the preheater gates are longer than usual, a pressure of 40 pounds per square inch is advisable, requiring approximately 35 cubic feet of free air per minute for a single burner preheater and 70 cubic feet for a double burner preheater.

EDMUND GYBBON SPILSBURY

A Memoir

By ALFRED D. FLINN

EDMUND GYBBON SPILSBURY, mining and metallurgical engineer of international reputation, died suddenly of heart failure May 28, 1920, in the New York Eye and Ear Infirmary, where the operation for cataract had been successfully performed upon his eyes a few days previous. He was President of the American Institute of Mining and Metallurgical Engineers in 1896 and of the Engineers' Club of New York in 1916 and 1917. He was also a member of the American Society of Civil Engineers, the American Society of Mechanical Engineers, the Institution of Mining and Metallurgy of Great Britain, the Mining and Metallurgical Society of America, the American Electrochemical Society, and of the Rocky Mountain Club of New York. As the representative of one or another of the national engineering societies, he was a trustee of United Engineering Society from 1916 until his death; a member of Engineering Societies Library Board from its organization in 1913 until 1920, being its chairman from 1918 to January, 1920; and a member of the Engineering Foundation Board from 1916 until his death. He was also a member of the Division of Engineering of the National Research Council, of Washington and New York. In all these societies and boards, he was an active, useful member, serving on numerous committees and contributing freely of his time and ability.

Born in London, England, in 1845, he attended school in Liege, Belgium, whither he went at an early age. His technical education was gained at the university of Louvain, Belgium; he was graduated in 1862. After leaving the university, he had a practical course at Clausthal, Germany. He came to the United States in 1870. His practice as a consulting mining engineer and metallurgist took him into many parts of Europe, Africa, the United States, Mexico and South America.

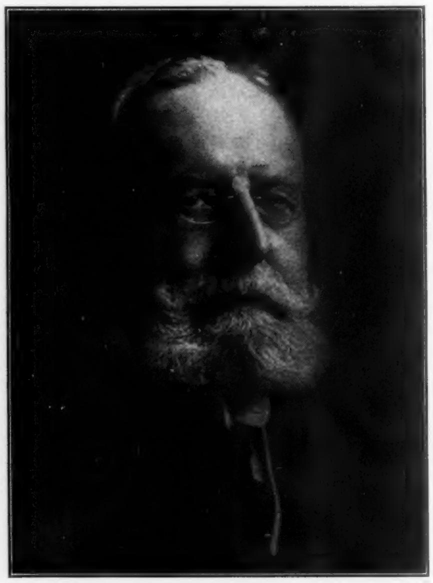
In 1870 he was sent by the Austro-Belgian Metallurgical Company to investigate the resources of the United States in lead and zinc. After spending two years in this work, he resigned in order to practice in the United States, where he was the first to introduce the Harz system of ore-dressing for the zinc ores of Pennsylvania and New Jersey. During this period he was engaged in explorations also on the northern shore of Lake Superior and in Colorado, Montana, Utah and California. From 1873 to 1875 he was engaged in different capacities with various companies until in 1888 he became managing director of the Trenton Iron Company, Trenton, New Jersey, where he remained until 1897. While manager of these works, he introduced as specialities of their business, the Elliot locked wire rope and the Bleichert system of aerial tramways.

In 1893 he presided over the sessions of the Mining Division of the International Engineering Congress, of the World's Fair at Chicago.

He was the author of a number of important technical papers published in the *Transactions of the American Institute of Mining Engineers*, on *Rock Drilling Machinery*, in 1874; *New Air-Compressor*, 1879; *Iron-Ore Deposits on the James River*, 1880; *Gold Mining in South Carolina*, 1883; *Notes on a Novel Cable-Transfer for Railroad Cars* and the *Use of the Locked Wire Rope*, 1891; *Improvements in Mining and Metallurgical Appliances During the Last Decade*, 1897; and in the *Engineering and Mining Journal*, 1910, *New Method of Agitating Cyanide Pulp*.

In a lighter vein he wrote entertainingly. To the *Mining and Scientific Press* in 1915, he contributed *Technical Reminiscences*. Paragraphs from this narrative recall early interesting experiences and the notable progress in mining engineering during his half-century of active practice.

"I wonder how many mining engineers of the present day can call to mind changes due to the advances in the practice of mining which have taken place in the last half-century? Practically every appliance beyond the pick and shovel, hand-hammer and drill, has been introduced during that short period. When I first started my practical course in underground work, we knew none of the aids now considered requisite to work economically. We had no machine drills to save the physical labor of hand work. Dynamite or its precursor, nitro-glycerine, had not yet been invented; fuse was still unknown; even steel was more or less of a luxury, and our hand-drills were still made of iron with steel bits welded on to them. The mushrooming of the head of the drill under the hammer blows was a constant source of trouble and injury to the hands of the miners. The only explosive known was the large-grained black powder.



Edmund Gybbon Spilsbury

"It seems hardly credible to-day, and yet it is a fact that the contract price for driving or stoping ground was influenced by the condition of the rye crop. In seasons of drought, the height of the rye was much curtailed and the length of the straw between joints would be so short that the time occupied in jointing and filling the straws which were used as fuses, greatly lessened the driving capacity of the miners. The straw primers naturally limited the possible depth of the hole and three feet was considered a good average. These straw fuses were very rapid and it was necessary to ignite them by a slow-burning sulphur wick.

"In the German mines the men all assembled in the foreman's office for prayers before beginning their shift. Except under special conditions no men were allowed to be raised or lowered by the hoisting engine; the ladders being used both for entry and exit. In some of the very deep mines, however, a special hand-engine was used, greatly lessening the time spent in climbing ladders."

Mr. Spilsbury is survived by three sons, Raymond G., Percifor G. and Hugh G., and by one daughter, Miss Beulah G., and a sister, Miss Matilda Spilsbury.

COMPRESSED AIR MOTORS

The compressed air motor is the only one that has proved successful in model aeroplane practice outside of the regular rubber band type of motor, according to a writer in *Aerial Age*. Many steam engines have been tried with little if any success. Prof. Langley built one that really worked and worked well. A few others have been built and have performed well, but about 95 per cent. of all steam engines built have never operated perfectly.

The compressed air motor on the other hand is simpler and of course can be made lighter. Very few if any have failed to function, and owing to the light weight are desirable for model aeroplane work.

There are many types on the market to-day at little cost, some have been made to sell for $15, others up to $100.

There is some satisfaction in having a compressed air motor in a model, for three reasons. The first is because it is a motor plant and takes the model out of the toy class; secondly, it brings the center of gravity up where it would be in a large machine, and thirdly, it lasts many times longer than a rubber band motor, or it can be transferred from one model to the other.

The Aeronautic Library has announced that they are carrying a full line of compressed air motors designed and built by Mr. Beach, an Australian having years of experience, and the writer personally examined the motors and found the workmanship the best, the design simple—which permits light weight—and the motors very efficient. To show how well these motors perform, I reversed the engine by hand and counted forty turns. The motor when released made 37 revolutions in the other direction, showing how well the valves and pistons hold the air.

The motors on exhibition at the Aeronautic Library are one large and one small three-cylinder rotary, and one large two-cylinder opposed. These motors are made in such a way that they can be connected up to a flash boiler and operated with steam pressure.

The Ingersoll Rand Co. of Illinois announces its removal on May 1 from its former Chicago offices in the Peoples Gas Building to No. 709 Fisher Building, Chicago.

The Manufactured Ship a Potent Factor in our Fleet of Trade

Compressed Air is Playing a Prime Part in this Accomplishment—Use of Pneumatic Tools Indispensable to Speed of Production and Uniformity of Procedure

By Robert G. Skerrett

PUTTING The Punch in Shipbuilding! Such might well be the title for a story descriptive of the part played by pneumatic tools in calling into being our present-day merchant marine.

But for the aid of compressed air it is difficult to picture how we could have produced the immense volume of cargo-carrying tonnage fashioned here in the course of the last three years or so. Not only that, but we shall see shortly how these air-functioned apparatus are going to do much towards enabling us to maintain a befitting position in the realm of oversea trade. The manufacturing world at large has come to a pass where mechanical agencies must figure more vitally than ever before in assuring quantity output. Brawn and manual skill, as heretofore understood, can no longer measure up to modern productive demands.

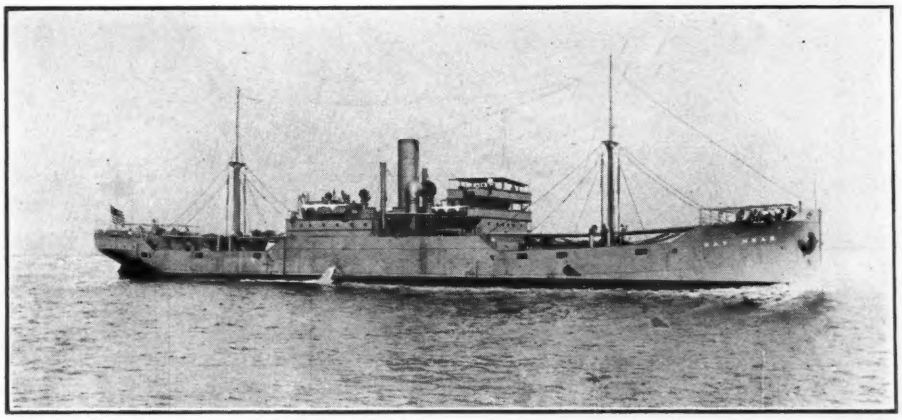
When the Submarine Boat Corporation essayed to blaze the way in a radical departure in marine architecture by initiating the standardized, fabricated ship, the men responsible for that epoch-making innovation realized that they could not turn out the desired number of freighters with exceptional rapidity if they relied upon means and methods previously prevailing. It was equally evident to them, however, that the mere multiplication of bottoms would not suffice unless those vessels were rugged enough to meet the conditions imposed by the Atlantic Ocean in its ugliest moods. In short, the steamers were to be turned out quickly and yet of such structural strength and finish that they would subscribe to the highest standards of the maritime rating agencies.

The opinion has prevailed somewhat widely that the underlying purpose of the U. S. Emergency Fleet Corporation was to obtain in any way practicable a vast array of craft which, by mere numbers, would neutralize and possibly outweigh the ravaging activities of Teuton U-boats. And it has been concluded, in the same fashion, that we embarked upon a contest of construction against destruction content if our freighters held together for only a trip or two. Whatever ground may have existed for this belief, it is undeniably the fact that the Submarine Boat Corporation took upon itself contracts for 150 steamers determined to build those boats in a way that would make them comparable with the best practices of leisurely peacetime shipyard work.

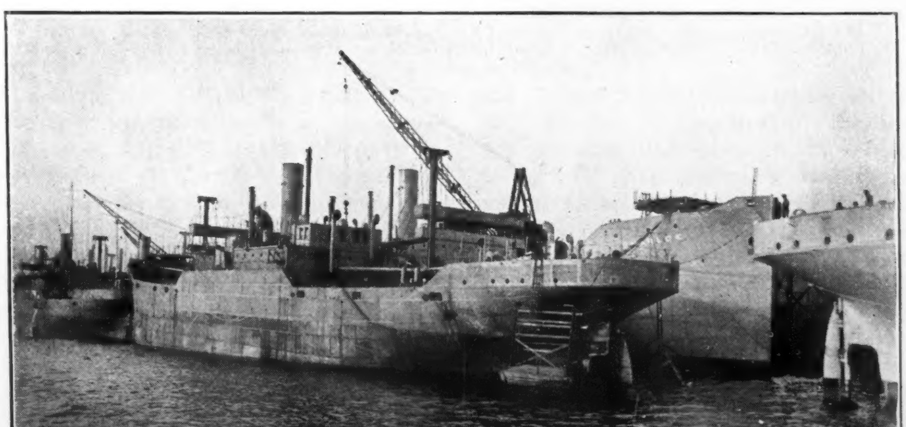
To this end, the bridge builder, the tank builder, and others thoroughly familiar with the varied departments of great structural steel undertakings on land were asked to turn their talents into untried paths and to bring their technical and manual skill to bear in producing floating bodies—ships of considerable speed and of a size equal to a deadweight carrying capacity of 5,350 tons. The tale would be an absorbing one if space were available to tell how the structural engineer and the marine architect met upon common ground, and, by mutual concessions, borrowed freely from each another and finally designed a type of cargo carrier that could be turned out by manufacturing methods—using steel shapes and plates that had never before been deemed suited to the getup of ocean-going craft.

Fundamentally, interchangeability of structural elements was the keynote; and this precision of manufacture or fabrication at scores of contributive plants—scattered throughout a far-flung area in several States—could not have been guaranteed except by the adoption of precautionary measures familiar to the bridge builder but quite unknown among the usual shipyard fraternity. That is to say, each plan was drawn with the utmost care and so fully dimensioned that the true form of every part and the exact position of every hole was established to a nicety. Further, paper templates or patterns, made of a special material, were distributed to each distant fabricator who, in his turn, could make therefrom durable metal or wooden templates. This reduced to a minimum any likelihood of template deformation in transit.

The use of paper may seem of doubtful merit, aware as most of us are that paper is likely to shrink or stretch according to the state of the atmosphere. But just see how these physical shortcomings were effectively met. On each pattern was drawn or painted a line of definite length, and so marked. If this line subsequently fell short, owing to contraction, the paper was dampened by steam until it expanded sufficiently, or, if affected by moisture, it was dried—contours and rivet holes being checked off on metal or wood



Manufactured standardized ship of 5350-ton deadweight capacity, built at the Newark Bay Shipyard.



A view of a short stretch of the fitting out dock showing something of the crowded condition of that busy section of the great plant.

Working with Pneumatic Tools at Newark Bay Shipyard

Fig. 1.—A corner of the Training Department's outdoor school. These learners are paying for themselves by doing effective work on ship parts. Fig. 2.—Getting down to it. A recent graduate of the Training Department caulking a deck seam. Fig. 3.—A rivet heater under instruction "on the job" at Newark Bay. Fig. 4.—The pneumatic reamer clearing up rivet holes preparatory to driving.

when the dimension of the standard line agreed with a steel tape. Finally, in order that there should be complete uniformity of measurement in every fabricating shop, all of the steel tapes used were compared with a single master tape and any variations, plus or minus, calibrated before the tapes were issued. The maximum tolerance permitted in any structural part was 1/16th of an inch; and it is noteworthy that out of some tens of thousands of pieces delivered at the Newark Bay Shipyard only 0.14 per cent. failed to conform to the prescribed limit of variation. However, the departures were so slight that even these units could be made acceptable with little work at the assembling plant.

There were two purposes in adopting the unique type of craft sponsored by the Submarine Boat Corporation. The aim was to make available for shipbuilding an enormous tonnage of commercial steel and, besides, to recruit to marine work a large force of operatives familiar with the rearing of steel spans, skyscrapers, hydro-electric flumes, etc. At the time we entered the war, wellnigh every shipyard mechanic in the country had been grabbed up by the existing plants, and it was perfectly plain that we should be dreadfully hampered in the execution of the Emergency Fleet Corporation's program unless capable labor could be had promptly. Therefore, it was realized that the nucleus of the productive army at Newark Bay and elsewhere, where it was decided to build fabricated freighters, would have to be formed of men accustomed to erecting steel parts and to handling the appropriate tools.

Appropriate tools, as the bridge builders in charge at Newark Bay understood the term, could be none other than pneumatic tools; and from the very beginning down to the present time not a single rivet has been driven by hand. As it happened, one set of hand-riveting tools were surreptitiously carried into the plant, but they were discovered before they could be put to use and ordered out of the establishment. For good and sufficient reasons, the management would not tolerate anything but the pneumatic "gun" for they believed that apparatus indispensable to speed of production and to uniformity of procedure. In no other way would it have been possible to fix general standards of execution and to apportion rates of compensation that would give all riveters an equal chance to win a satisfying wage.

There was another end to be gained by the universal adoption of air-driven tools. It was

Interiors of the standardized ship—Living quarters of crew.

Fig. 1.—The seamen's mess aboard one of the ships built by the Submarine Boat Corporation. Fig. 2.—The kind of bunking accommodations which the Newark Bay steamers provide for their sailors. Fig. 3.—A corner in the seamen's quarters where hot and cold shower baths are available and where radiators are fitted to dry their wet togs. Fig. 4.—The holds of the manufactured ship are roomy and so generally free from obstruction that they facilitate the handling and stowage of cargo.

thought that it would be easiest to familiarize new men to use them efficiently, and thus by a comparatively short period of practical instruction to make greenhorns into much-needed capable mechanics. Remember, please, that the Newark Bay Yard expected, if the war continued, to have a working force of quite 18,000 persons; and as a matter of fact its operative army has totalled substantially 15,000. How the ranks of the mechanics were swelled from month to month and skilful toilers created from unexpected walks of life is a heartening bit of industrial history. More than that, it will dawn upon us, as we sketch the methods employed and the results obtained, that the urge of strife has yielded fruits of a valuable and enduring nature.

In the spring of 1917, the steel shipyards of the country were employing about 26,000 men —they were anxious to have at their command many more. Official estimates developed the fact that within the course of a twelvemonth fully 400,000 workers would be needed, and the prospect was that in the course of the succeeding year the shipbuilding army would have to be augmented 50 per cent. Clearly, these operative cohorts could be had only by adopting some system of intensive training that would suffice to make riveters, caulkers, chippers, reamers, etc., out of men previously unacquainted with the handling of tools suited to these callings. How the Newark Bay Shipyard met the situation and accomplished educational wonders is another evidence of traditional Yankee resourcefulness.

The first step was to pick out promising employees, identified with kindred trades, who had already served in supervisory capacities. These men were appointed student instructors and were sent for six weeks to a special training school established at Newport News, Virginia. Their main duty there was to learn how to analyze the respective tasks of the shipyard mechanic, and to grade them agreeably to their difficulty to master. In this way, the instructor-to-be was qualified to take a beginner in hand and to lead him progressively and sympathetically through jobs that would ultimately produce a qualified workman. This meant, of course, fitting the teacher to impart information in an intelligible and a stimulating manner.

When graduated from the Newport News course, the original twelve instructors returned to Newark Bay where their initial effort was to amplify the local instructional force by training on the spot sixteen other men. In this way, the training staff was built up step by step until it numbered 105 instructors by January of 1919—these teachers, at that time, being busily engaged in guiding no fewer than 1,052 novices in sixteen different branches of shipyard work. To be specific, the several classes turned out riveters, chippers and caulkers, holders-on, reamers and drillers, heaters, bolters, regulators, pipefitters, packers, erection machinists, etc.

Of course, this procedure had the outward appearance of entailing very heavy expendi-

tures and, for a considerable interval in the case of each learner of carrying with it an overhead without a commensurate return. But we must bear in mind that the system in no wise resembled the commonly prevailing apprentice or helper method. Instead, from the very start, the plan required that every pupil should be engaged in turning out work of a kind that could be used in the actual getup of the fabricated craft. How was this made possible? Why, for example, the riveter-to-be during his first half day at the yard was set driving rivets in ship parts although not immediately employed in doing riveting on the vessel, itself; and in the same way reamers, buckers-up, etc., were given practical and profitable jobs to do.

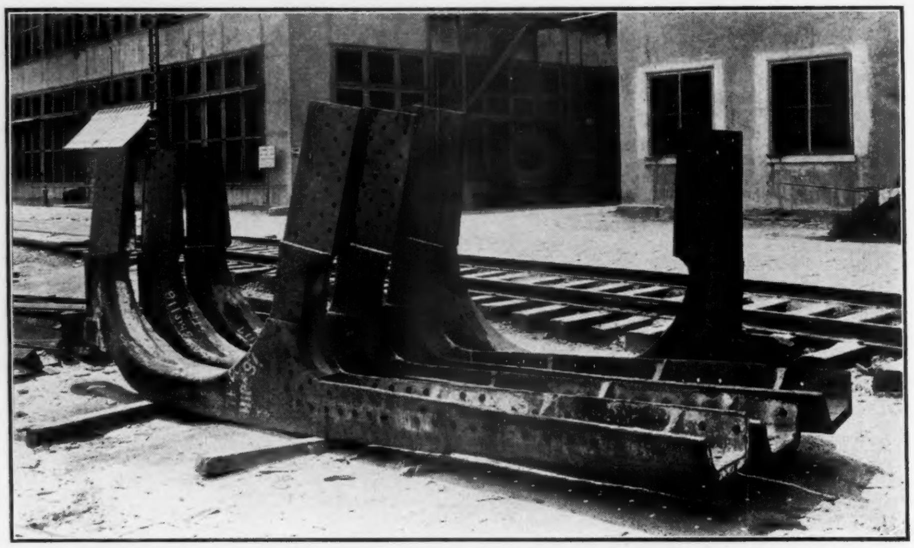
A section of the yard in the neighborhood of one end of the building slips was laid off as an out-door "school" for the Training Department. There the learners, qualifying in hull-construction trades, were and still are given their first lessons on frames, girders, bulkheads, floors, etc. According to the nature of their respective requirements, the various hull units are bolted, reamed and drilled, riveted, chipped and caulked by the novitiates. At the same time, rivet heaters are taught their particular calling by acting as such for the tyros doing their bit with the pneumatic hammers. The rivet production of the entire Training Department has averaged anywhere from 45,000 to 62,000 rivets per week; and it is significant that less than two per cent. of the rivets driven by the members of the classes have had to be cut out because of improper workmanship.

At each instructional stage emphasis is laid upon quality of performance; and the successive tasks are attacked in a manner to promote a gradual increase of speed of performance. There is no specified time fixed for mastering any of these shipyard trades; and a learner remains under instruction so long as he makes headway and displays willingness to fit himself. The slacker is promptly discovered. When the schooling is ended, the newly-made mechanic is passed onto the building ways and, as a rule he soon proves himself capable of holding his own with the regular workmen. Nothing indicates better the thoroughness of the preliminary instruction than the fact that quite 96 per cent. of the student workers make good. In the course of two years the Training Department at Newark Bay converted 13,000 men and lads from many walks of life into competent shipyard operatives.

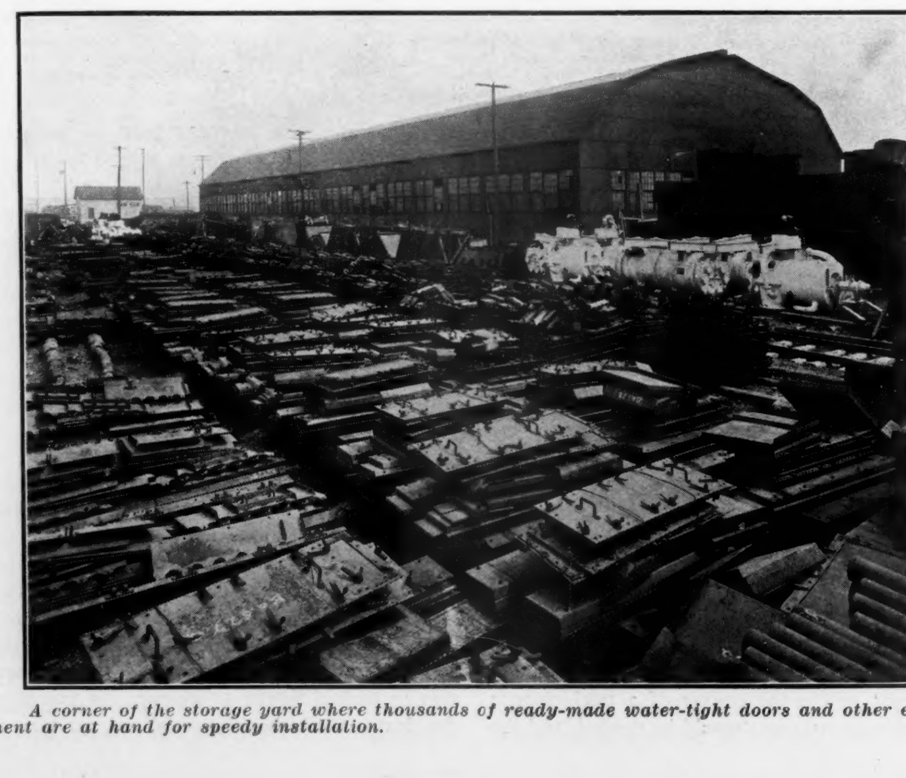
The functional simplicity of the pneumatic tool has lent itself peculiarly to the training system adopted at Newark Bay, and the results obtained have stirred the old-line shipbuilding fraternity profoundly, and well they might. It may not be a matter of common knowledge, but abroad—especially in the marine plants of the British Isles, not more than ten per cent. of all the riveting is allowed to be done by the pneumatic hammer. There are two reasons for this: first, the long-established unions of the hand workers are opposed to the "air gun," and, secondly, there has prevailed among the conservative school of shipbuilders a belief that the pneumatic tool makes less of a demand for skill on the part of the mechanic and is all too apt to promote imperfect workmanship. No wonder, then, that the established steel shipbuilders here, when we joined in the war, looked askance at the potential participation of the structural steel man in marine architecture. Many of these doubting gentry did not hesitate to say that the bridge worker and his brothers could not drive a rivet tight enough to meet the stresses of sea service. How unwarranted this conclusion was has since been made plain by the splendid performances of the fabricated freighters put afloat by the Submarine Boat Corporation. But before touching upon the sea-going records of these craft, let us finish with the efficiency of the plant's operatives and the procedure adopted to speed up construction or assembling—call it which one will.

To facilitate the employment of time-saving pneumatic tools, there are raisers at numerous points along both sides of each building slip, and these, at brief intervals vertically, are fitted with groups of taps. By this arrangement it is practicable, even with comparatively short lengths of air hose, to reach any part of a craft in course of construction and thus to do the necessary riveting, caulking, reaming, chipping, etc., no matter where the job may be. The motive breath for the 4,250 odd air-driven tools is supplied by twelve electrically actuated compressors, and the aggregate energy needed for this service amounts to the tidy matter of 7,500 horse power. Operating current is supplied by the big Essex Power Station some two miles away on the Passaic River. The immediate distribution of air at the 28 building slips depends upon seven compressors—each machine taking care of a group of four ways.

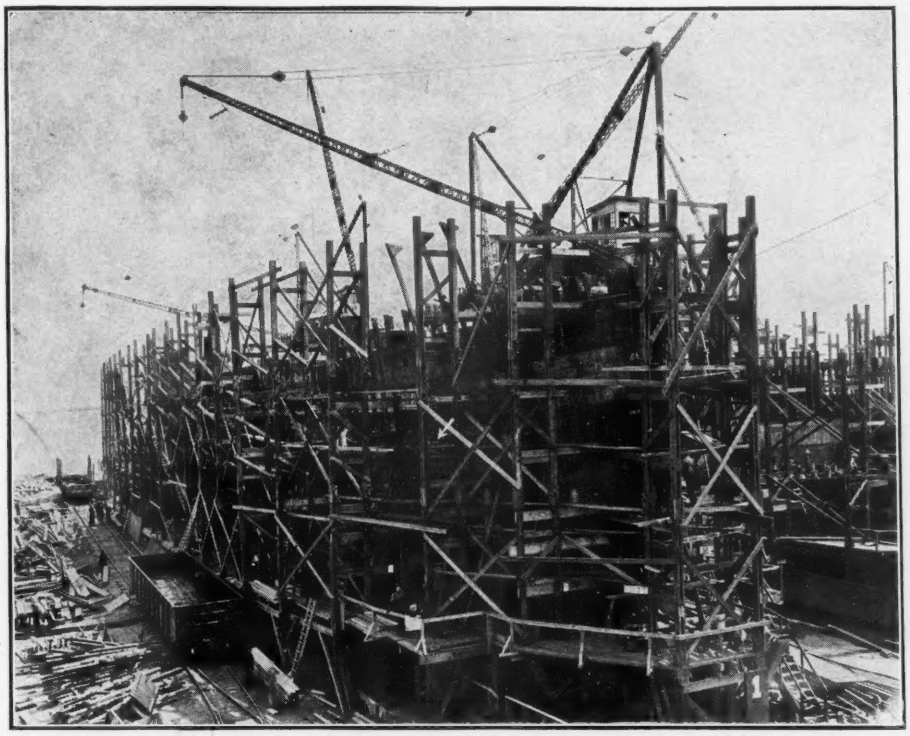
The seven compressors at the ways, like three others located along the fitting-out dock,



Some numerous difficult forgings of identical pattern in stock. This interchangeability makes it possible to meet the needs of ships under construction or to supply promptly replacement parts for damaged fabricated steamers.



A corner of the storage yard where thousands of ready-made water-tight doors and other equipment are at hand for speedy installation.



The fabricated freighter in course of construction. Arrow shows one of the risers of the compressed air supply system with its numerous taps for the different working levels.

have a capacity of 3,300 cubic feet per minute. In the fabricating shops, where material for the bows and sterns are worked up locally, the two smaller compressors have each a capacity of 1,650 cubic feet per minute. The installation by which compressed air is delivered to the various points throughout the yard consists of a six-inch main, running largely under ground and fed by the ten big machines. Along the fitting-out dock, however, the main is supported beneath the crane trestle and, therefore, is overhead. There is, besides, a pipe line tapping the latter conduit about midway of the dock, and this extends to the fabricating shops and on again to the farther end of the building slips—thus constituting, in effect, a ring system of air supply. Each compressor is provided with a receiver of the usual type; and there are supplemental receivers placed at suitable positions along the fitting-out dock or wet basin.

Compressed air is fed, in addition to the tools already described, to the rivet heaters or portable forges of which there are 423. The same motive medium is used to function the hammers in the blacksmith shop, to operate a number of pneumatic hoists, and to drive portable punches and riveters in the fabricating shops. The pumps on the fitting-out dock, which deliver fuel and lubricating oil to the vessels, are also actuated by compressed air, and so, too, are some of the steam pumps on the boats at times when their boilers are not in service. Large torches employed on steel work during hull construction likewise tap the air line; pneumatic tamping machines are used to keep the railroad track in proper condition; and, finally, air does its part in working the spray guns by which large areas of the freighters' bodies are painted expeditiously. This brief resume of compressed air's divers activities at the Newark Bay Shipyard indicates suggestively the wholesale manner in which this energizing element enters into the rapid building and the satisfactory finishing of the fabricated cargo carrier.

For the purpose of regulating compensation and, at the same time, bunching piecework, the management of this splendid plant devised what is known as a berthing system. This, in effect, divides each hull into so many distinctive job areas, and the result is beneficial in several ways. It obviates troublesome accounting due to scattered and somewhat petty piecework tasks; it concentrates a man or a gang's activities for half a day or a whole day where the least amount of shifting will be necessary; and the pay is large—the psychological reflex inducing sustained and cheerful effort. Of course, the primary difficulty was to apportion the "berths" so that their scopes would agree pretty closely with the difficulties involved—the less accessible berths calling for fewer rivets to be driven during a regular working day. But the berthing scheme has represented only one phase of skilful management at Newark Bay.

With characteristic thoroughness, the bridge men in charge at the plant, following out their accustomed lines of procedure, cunningly evolved a "sequence of erection" which would permit of the quickest assembling of a hull and, incidentally, facilitate the riveting and the regulating or aligning of associate parts. Heretofore, ship construction in the average yard has consisted of erecting certain features of a hull after they were more or less extensively fabricated in the near-by shops of the plant. These sections, generally the keel and frames, were brought together on the ways and from them templates were made which served in laying out the plating and other units of the craft's body. This required the lining up and ribboning of the frames to hold them in position so as to secure even approximately correct templates. Because of variations in the positions of the framework elements, it has commonly been necessary to make a separate template for every plate!

At Newark Bay, on the other hand, the erecting proceeds in a somewhat reverse order. The flat keel plates and the vertical keel are first placed on the blocks, then certain extensive parts of the shell are assembled before a single rib is secured to the vessel's backbone. Next, the frames are slipped in and faired to the skin plating. This course would invite difficulties and possibly entail deformed lines if it were not for certain expedients which the bridge worker calls to his aid. Further, ex-

Another "shelf" of the well nigh inexhaustible "stock room" of Newark Bay from which capstans, windlasses, etc., can be withdrawn instantly to go aboard any of the standardized manufactured freighters.

The air dolly in action

actness of fit and satisfactory contours are assured by reason of the precision of the distant fabricating shops in cutting, punching, and riveting up much of their materials.

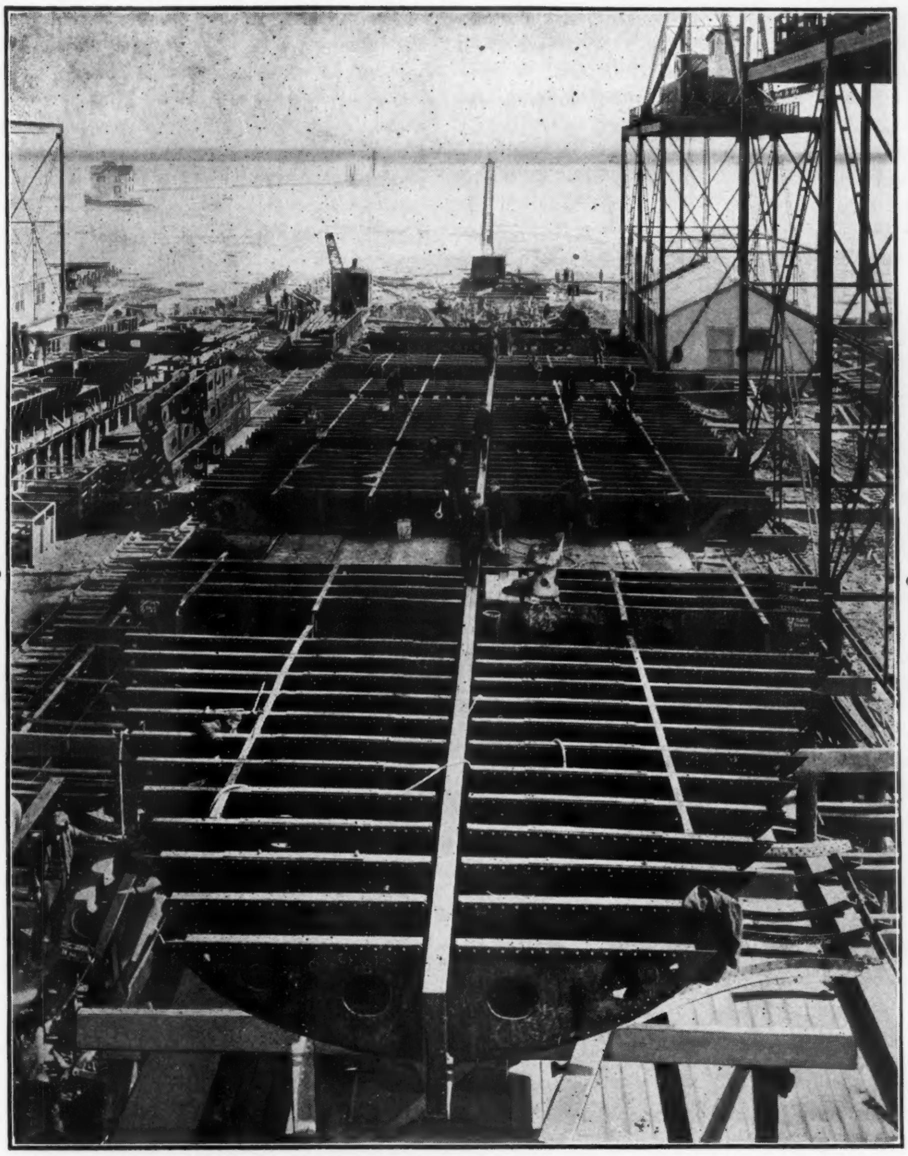
The bridge builder does not hesitate to utilize the civil engineer; and the latter's transit and his keen eye make sure of the desired straight lines. Similarly, the structural steel man knows from experience that he can bring together temporarily by bolting large sections of his prefabricated structure, "regulate" to a nicety their relative positions, and then bind them by rivets when ready. The bolters are expected to do their work thoroughly instead of more or less approximately, as is so often the case in the average marine plant. There is nothing new in this procedure to steel erectors. Careful fabrication at the contributive mills and shops has made this relatively easy. The builders of our skyscrapers and bridges are aware that their rivets are intended to link securely rightly adjusted steel elements, and they know that the rivets should not be counted upon to bear the added stress of *forcing* parts together. As a consequence, in the ships assembled at Newark Bay, the rivet, in chilling and contracting, establishes a state of initial tension which adds just so much more to the snugness of the union and to the firmness of the bond between metal and metal.

In somewhat inaccessible places, where the holder-on or bucker-up cannot play his part easily or efficiently, there has been devised what is popularly termed an "air-dolly." This ingenious little apparatus consists of a cylinder with a plunger or piston rod surmounted by a head which is projected by pneumatic pressure —thus forcing the rivet into position and holding it against the opposing impact of the "gun." In this way a snugness of fit and a type of workmanship are obtained which could not be certainly realized otherwise. Not only that, but the rivet can be hammered tight while hot and plastic. At Newark Bay, "double driving" is being extensively employed to advantage. That is to say, the somewhat passive function of the bucker-up is supplanted by giving that mechanic a "gun" which he brings against the rivet to steady it until his fellow on the opposite side has given the rivet a number of taps. Then, both of the gunmen take up the driving, and between them the rivet is forced home and finished off in a very superior manner. This order of working likewise makes for speedy performance.

And what has been the cumulative result of the training system and of the means and the methods employed by the Submarine Boat Corporation? As everybody knows who is at all familiar with either land or marine structural steel work, progress is judged by the number of rivets driven in a given period. Incidentally, let it be said that each of the Newark Bay freighters has in its make-up a matter of fully four hundred and fifteen thousand rivets; and while an immense percentage of these are driven by machine and "gun" at the fabricating shops, still many thousands of them have to be driven at Newark Bay. When work was first started at the plant and the keel of Hull No. 1 was laid on December 20, 1917, the men employed on the job represented normal skill in the trade. The *Agawam*—for such was the name of the maiden craft launched on the 30th of May, 1918, was produced when the personnel was essentially new to the vast undertaking, and she constitutes a starting point from which to measure achievement since. From January to June of 1918, nineteen rivets per gang hour was the average performance of skilled labor, and the mean of the men under training was eleven rivets per gang hour. During the last six months of that year, due in part to the grim urge of war, the average of the efficient workers climbed to 23 rivets per gang hour, while the Training Department obtained a rating of twelve rivets in the same measure of time. In 1918 the plant launched twenty boats.

Gradually, in the next twelvemonth, despite the fact that strife had ceased on the battle fields of Europe, the riveting records improved conspicuously, and by the close of 1919 skilled labor was driving on an average 50 rivets per gang hour, and the employees of the Training Department were making an average of 16


Observe that the keel and much of the bottom plating are in place while not a single frame has yet been erected. Notice, too, that the floors are delivered to the building slip in an advanced stage of fabrication.



The early stages of the assembling of a fabricated cargo carrier. The keel is typical of the girders commonly employed in the building of bridges, great skyscrapers, etc.

rivets—just three rivets less than the original so-called experts drove in the early part of 1918. Last year the yard put overboard the amazing number of 83 ships, representing a total of 444,050 tons deadweight capacity! At the present time, experienced operatives are driving an average of 56 rivets per gang hour, and the learners can boast an average of 24 rivets an hour—five better than the skilled rating when the *Agawam* was building.

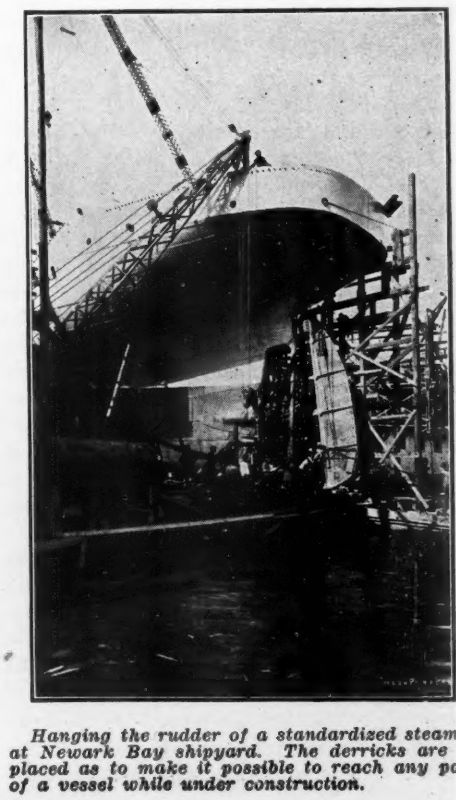
This showing is all the more commendable and significant when we realize that the nation is no longer confronted with the menace of the U-boat. In short, the yard has struck a peacetime stride that still is gaining; and this fact is going to have a deal to do with our ability to compete with the foreign builder and to make it possible for us to deliver tonnage within contract periods quite unapproached abroad where hand riveting predominates. Extremely capable management has brought these things to pass; and pneumatic tools have disclosed a commensurate adaptability in meeting an unusual situation. It is interesting to speculate what the same administrative cunning and these mechanical facilities will lead to in the near future.

One might expect the S. S. *Agawam* to have shown some structural shortcomings—being as she was the first of our fabricated cargo carriers; but she proved unusually sound even when her double-bottom tanks were subjected to a decidedly abnormal test. The ship, like all of her class, was designed for a maximum draft of 22½ feet, and it is customary to make a hydrostatic test agreeably to the intended draft. However, to the astonishment of the inspectors of the underwriting agencies, a 30-foot head of water in the standpipe failed to reveal weeping at any joint or rivet. Today, the practice at the yard calls for a testing head of 34½ feet, representing approximately a hydrostatic pressure of fifteen pounds to the square inch. And the skeptics said that bridge men were not qualified to build tight ships!

As every man of nautical experience or maritime knowledge is aware, the tightness of a steel hull is not only a measure of structural strength and a fair gauge of service endurance, but it is an excellent index of low cost of upkeep and a guaranty that cargo liable to damage by water can be carried with the least likelihood of injury. On her maiden voyage the S. S. *Agawam* was loaded with refined sugar destined to a Mediterranean port. Owing to a succession of unexpected conditions, the ship was delayed in making that haven, and the sugar remained in her hold for a period of several months before it was discharged at Naples. In the course of her voyage the *Agawam* had to contend with storms and heavy seas. When the sugar was discharged not more than one-half of one per cent. was hurt, and the damage was so slight that the affected sugar was still fit for consumption. The bilges were dry, but an imperfectly sealed hatch cover had permitted the seas sweeping over her deck to set up moderate leakage.

Further evidence of hull tightness has since been brought to light when some of the steamers, carrying fuel oil in the double bottom have been dry-docked. Petroleum will seep through passages that will hold water at bay, and it is no uncommon occurrence for the under-water skins of tankers and other oil-laden vessels to be literally coated with a dripping film of this "searching" liquid. In fact, this is the usual state and causes no alarm. It is therefore easy to appreciate the surprise of commanding officers and engineers of Newark Bay ships at a total lack of oil seepage when their craft were dry-docked. This has constituted spectacular proof of the extraordinary soundness of the hulls.

Like other vessels exposed to the hazards of the sea, some of these fabricated freighters have had to battle strenuously with the elements and, occasionally, grounding has occurred. One of the fleet was swept ashore on the coast of Cuba during a driving hurricane, and was left exposed to the changeful elements for several months while she wallowed about in the sand. Contrary to what might have been expected, the craft was "rocked off" during the high tide of rough weather and refloated without showing any structural



Hanging the rudder of a standardized steamer at Newark Bay shipyard. The derricks are so placed as to make it possible to reach any part of a vessel while under construction.

impairment that would occasion a leak. Indeed, the S. S. *Hillsborough County* was so little affected by her experience that the underwriters, without ordering repairs, permitted her to steam north to Baltimore. Again, we have in this case, one more example of the thoroughness of the work and the fitness of the material which have made the standardized, manufactured vessel possible.

Finally, while the boats, in using structural steel, have about 35 tons more metal in their hulls than craft of the same type and dimensions built strictly according to Lloyd's rules, still this difference is more than compensated for by the increased strength gained; and the rigors of service have brought to light that the "soft steel" employed will stand harsher treatment—giving and bending without rupture where the usual higher carbon ship steel will snap or fracture and let in water.

The standardization that has contributed so much towards rapid construction lends itself equally to promptness in effecting repairs, all because of that perfection of workmanship in every contributive feature which assures interchangeability. The storage yards and the storehouses at Newark Bay are typical of the "shop-shelf" idea. There are held in reserve ready for instant issue a numerous array of plates, angles, forgings, auxiliaries, and equipment of all sorts which can be worked into a new steamer or used to substitute any damaged part or feature of an operating vessel. These can be fitted either at the yard or dispatched to any other port where the ship in need has touched. Many instances might be cited revealing how this interchangeability has permitted prompt and low-priced replacements and held down demurrage to a minimum. The shipping fraternity is fully alive to the value of this expedition, for they know that the fabricated freighter can therefore be kept more steadily on her money-making job.

From a patriotic point of view, this new-style of cargo-carrier will inevitably do much towards arousing the American people to a "sea-minded" attitude—a psychological status indispensable to the proper support and maintenance of a commensurate native merchant marine. This will be the logical outcome of the material interest of a widespread nature provoked by the recruiting of productive agencies in many of our States otherwise not directly concerned in nautical matters. As has been well said by one of the officers of the Submarine Boat Corporation: "A plate from Wheeling, West Virginia, is riveted to a section from Louisville, Kentucky, and assembled to a frame from Milwaukee, Wisconsin." Similarly, apparatus and material are supplied from a region reaching from Massachusetts south to Virginia and inland for many hundreds of miles.

Of the three fabricating yards called into being to meet a war-time emergency, the Newark Bay establishment is the only one reorganized for general commercial activities and scheduled to develop elaborately. The program now outlined looks to the purchase of the property from the Government at the termination of the present four-year lease. Further, the plan is to create supplemental facilities in the way of dry-docking accommodations, and then to build an array of piers of the most approved design which shall be provided with thoroughly up-to-date loading and unloading equipment. In other words, ships are to be built, repaired, and operated directly from that site on Newark Bay where a number of our great trunk line railroads can be tapped. In this way, the principles of standardization will be applied to the manifold fields of oversea shipping; cargoes will be handled in the most direct and expeditious manner; and it will be possible with these focused conveniences to shorten turn-around periods—hastening the recently arrived steamer off again upon a profitable voyage. The vision, the courage, and the coöperation which made the Newark Bay Shipyard an achievement of the first order are going to prevail in carrying on the larger and more splendid project. The standardized, manufactured freighter has come to stay, and will undoubtedly be a potent instrument in aiding America to hold its own against all competition in the markets bordering upon the Seven Seas.

THE "DANIAL WAKALL" WATER BLAST IN MINES

This is a new device which is being introduced into English mines providing means for the allaying of dust and deleterious gases in mine air, by utilizing water under pressure, causing it to split into fine particles by striking solid surfaces, and subsequently atomized by compressed air. The device consists of an outer shell or casing, fitted internally with a plug valve, with two passages, one for the airway, and the other for the water. In the air passage a non-return ball valve is placed. The airway connects with a cylindrical sleeve, admitting the compressed air to an inner chamber through slots at the back end. Within this chamber is fixed an air regulating spindle with cone shaped face, forming a valve with the inner front head cone surface of the sleeve, acting as a valve seat. The extension of the spindle beyond the valve face is a distributing cone. The water passage connects with an annular chamber surrounding the front head of the sleeve, which has a cone face forming a valve with the outer casing as a valve seat. The screwed spindle is rotated within the sleeve, and the screwed sleeve carrying the spindle rotates with the casing. The plug valve is operated by a removable key. The functions of the device are as follows:—Compressed air and water under pressure are connected to the device by the usual pipe fittings. The key operating the plug valve is rotated through a quarter of a turn, admitting the air and water into their respective chambers. The screwed sleeve is rotated back to form the required aperture between the casing and the sleeve to determine the quantity of water used. The spindle is similarly adjusted within the sleeve, controlling the quantity of air used. The water under pressure issues from the chamber in a cone shaped jet, and striking the spindle, is split into fine particles. The compressed air issuing from the centre behind the water immediately projects the fine particles of water on to the head of the spindle, which deflects the atomized water into a cone shaped stream, the degree of atomization being controlled by the adjustable apertures of both the air and water. The non-return valve placed in the air passage of the plug is to prevent the back pressure of water entering the compressed air mains when the air pressure fails, or, for economic saving, is cut off after the blast has been in operation for a certain length of time. The removable key operating the plug valve can only be separated from the casing when the blast is turned full on. As the device is placed in direct connection with the air and water services, without any intermediate valves between the mains and the devices, the return of the key to an official is a direct proof that the water blast has been put into operation.

TESTING "ALCOGAS" FOR AIR MAIL SERVICE

Alcogas, a fuel more economical than gasoline, and less hard on the motor, was tested successfully in the air mail service, according to the announcement of Otto Praeger, Second Assistant Postmaster-General in charge of the air mail.

Tests made on the Washington-New York route, over a six weeks' period, indicated a saving of 3.3 gallons of fuel in favor of the new synthetic fuel. Known commercially as alcogas, it is composed of 38 parts of alcohol, nineteen parts benzol, four parts tuluol, 30 parts gasoline, and seven and one-half parts ether. The remaining one and one-half part is not explained, but the other components sound explosive enough.

Mail plane No. 35, a Curtiss machine equipped with a high compression motor, was the machine on which the new fuel was tested. A check plane of similar model flew the opposite way during most of the trips made, using high test aviation gasoline. The alcogas ship made thirty-one flights and the gasoline ship nineteen. Liberty twelve motors were used on both planes, but the alcogas ship was high compression style and the other low.

A saving in lubricating oil also was indicated by the tests. The average for the new fuel was 4.4 quarts an hour as against 4.98 quarts an hour with gasoline. The oil saving is thought to be due to greater thermal efficiency displayed by alcohol fuel as against gasoline. After 125 hours in the air the motor on the alcogas machine was taken down and found to be in fine condition, with less carbon deposited than in the motor using gasoline. At 1,475 revolutions a minute 24 gallons of gasoline were consumed an hour, while at the same speed but 20.1 gallons of alcogas were consumed.

Sheffield, the great center of British engineering, is utilizing the film to promote the British steel industry and to develop British export trade in steel products. A series of films will be shown this year in 86 of the principal cities of western Europe, America and the British colonies, which, experts consider, will be a fine advertisement.

FREDERICK G. COTTRELL TO HEAD BUREAU OF MINES

THE NOMINATION of Dr. Frederick G. Cottrell for director of the Bureau of Mines, Department of the Interior, was sent recently to the Senate by President Wilson, to take the place of Dr. Van H. Manning, resigned. Doctor Cottrell was the assistant director of the Bureau under Doctor Manning.

Frederick G. Cottrell, chemist, metallurgist, inventor, was born in Oakland, California, January 10, 1877. He attended school in Oakland and matriculated at the University of California in 1892. As a university student he gave especial attention to science, particularly chemistry. After graduation in 1896, with the degree of Bachelor of Science, he was a Le Conte fellow at the University in 1896-97 and taught chemistry at the Oakland High School in 1897-1900. Then he went to Europe where in 1901 and 1902 he studied at the University of Berlin and the University of Leipzig, receiving from the latter the degrees of Master

FREDERICK G. COTTRELL

Chief Metallurgist of the Bureau of Mines of the Dept. of the Interior who has been nominated by Pres. Wilson to be Director of the Bureau. He is a native of California and a graduate of the University of California.

of Arts and Doctor of Philosophy, 1902. On his return to this country in 1902, he was appointed instructor in physical chemistry at the University of California, and in 1906 was appointed assistant professor holding this position until 1911. While in college Doctor Cottrell's chief contributions to science were researches relating to the electrical precipitation of fume and fine particles suspended in the gases of smelteries, blast furnace or cement works flues, and he finally evolved what is known as the Cottrell process for this purpose. This invention was first utilized at the Selby smeltery in California for removing fumes from the waste gases of a sulphuric acid plant at the smeltery, thereby abating a nuisance that threatened to necessitate shutting down the works. Subsequently this electrical precipitation process was installed at other smelteries to remove fume and solid particles contained in the escaping gases, and it was also successfully used at cement plants, notably near Riverside, California, to prevent the dust from the calcining kilns from damaging nearby orange groves and vegetation. To-day the Cottrell process of fume and dust removal is in world-wide use, and is recovering materials heretofore wasted to the value of many thousands of dollars. One of the latest installations is at a large smelting plant in Japan; while the largest installation is at the Anaconda smeltery, Anaconda, Mont. Doctor Cottrell in a desire to encourage scientific research turned over his extensive patent rights to a non-dividend paying corporation, known as the Research Corporation, a body formed for that purpose. A fundamental requirement in the incorporation is that all net profits shall be devoted to the interests of scientific research.

In 1911 when Dr. J. A. Holmes, the first director of the Bureau of Mines, was serving as a member of a commissions appointed by the Government to study alleged damages from smoke and fumes from the Selby and the Anaconda smelteries, and the Bureau of Mines was investigating at length the smoke problem, Doctor Cottrell, because of scientific attainments and his special knowledge of metallurgical problems, was appointed chief physical chemist in the bureau. In 1914 he was appointed chief chemist, in 1916, chief metallurgist, and in 1919, assistant director.

Aside from his work on fume precipitation, Doctor Cottrell has been interested in and intimately connected with work on the separation and purification of gases by liquefaction and fractional distillation. During the world war and subsequently thereto the development of the Norton or Bureau of Mines process for the recovery of helium from natural gas has been his special care, and it was chiefly through his efforts that a plant for recovering helium (a rare non-inflammable gas) on a large scale for military aeronautics has been erected near Petrolia, Texas.

Doctor Cottrell is a member of the American Chemical Society, Mining and Metallurgical Society of America, the American Electrochemical Society and the American Institute of Mining and Metallurgical Engineers. He was awarded the Perkin medal by the New York Section of the Society of Chemical Industry in 1919 in recognition of his work on electrical precipitation.

Personal Intelligence

H. W. Seamon, president of the Trojan Mining Co., of South Dakota, and H. N. Lawrie, economist of the American Mining Congress, appeared before the House Ways and Means Committee recently, urging the passage of a gold premium bill. Production will cease unless relief is given, they said.

* * *

Geo. Otis Smith, Director of U. S. Geological Survey, in an address before the American Iron and Steel Institute in New York on industry's need of oil said in part: "The ever increasing demand for gasoline and fuel oil are the outstanding oil needs, so that the question of priority will soon arise. With an estimate of seven billion barrels in the ground and the 1920 consumption closely approaching 500,000,000 barrels, this rapid pace cannot long be maintained. Regard for the future forces us to plan to use less oil and to import more.

* * *

Roy S. MacElwee, New York City, assistant director of the bureau of foreign and domestic commerce, has been confirmed by the Senate to be director of the bureau to succeed Philip B. Kennedy, who resigned on July 1.

* * *

E. N. Gott, Vice-President of Boeing Airplane Co. of Seattle, reports that the work of mapping aerial routes between the United States and Alaska will be begun immediately with a view to instituting commercial lines to the territory from Seattle as soon as possible.

* * *

W. S. Connor of New York City has organized the Red & Green Granite & Products Co., a company in the State of New York, to manufacture granules for paper asphalt shingles, and also to make the shingles. The mill is being built in Granville, N. Y., and is expected to be operating by July 1.

* * *

Carl G. Barth, a pioneer in the machine building industry and in modern principles of production and management, has been elected an honorary member of the Taylor Society for the promotion of science in management, 29 West 39th Street, New York City. The other honorary members are Frederick W. Taylor himself and Henri Le Chatelier, who developed scientific management in France.

* * *

B. L. Clegg, who has been connected with the Westinghouse Electric Co. of 265 Broadway, New York, for the last eleven years, is now associated with the industrial department and is specializing in motors for their shops.

* * *

L. M. Baker has resigned as supervisor of sales in the Motor Equipment division of the Hyatt Roller Bearing Co. to become the exclusive representative in the State of Michigan for the Dittman Gear and Manufacturing Corporation, Rockport, N. Y.

* * *

N. N. Badd who formerly was in charge of the Heat Treating Department of the De La Vergne Machine Co. in New York has resigned to accept a position as Sales and Service Engineer with the T. A. Calhoun Co., 76 Montgomery Street, Jersey City, N. J.

* * *

The American Zinc Institute, Inc., at its recent annual meeting in Chicago, elected the following officers for the next fiscal year:

President, Eugene H. Wolff; Vice Presidents, James L. Bruce, Edgar Palmer, F. C. Wallower; Treasurer, Howard I. Young; Directors, Charles W. Baker, J. H. Billingsley, Joseph Brennemann, James L. Bruce, P. B. Butler, A. P. Cobb, Eugene R. Grasselli, Julius W. Hegeler, Cornelius F. Kelley, Carl M. Loeb, Edward M. McIlvain, A. S. McMillan, George E. Nicholson, William A. Ogg, Charles T. Orr, Edgar Palmer, Victor Rakowsky, William F. Rossman, Arthur Thacher, F. C. Wallower, Eugene H. Wolff.

AIR CLASSIFICATION OF PULVERIZED MATERIAL

*By S. B. KANSOWITZ**

IN THE grinding or pulverizing of materials some form of separator is used for securing a product of suitable and uniform fineness. The means employed have been screens and later air currents. In some cases the separator is outside of and distinct from the mill proper, that is, the discharge of the mill goes by means of an elevator, or screw conveyor, to a separator where the fines are removed and the tailings, consisting of coarser particles with more or less of the fines, are returned to the mill for further grinding. In other types of mills the separation is an inherent part of the mill, and no material leaves the mill until it has been ground to the proper fineness.

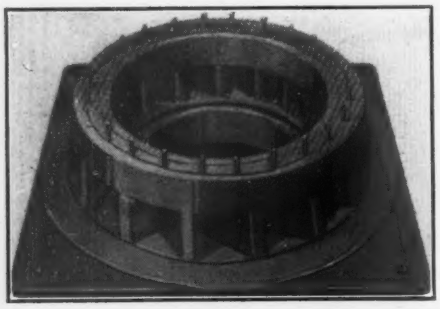


Fig. 1.—Base casting of pulverizer.

Standards of Fineness

When referring to the fineness to which a certain material is to be reduced there is often a misconception as to what the term really means. The term "mesh" is used freely, such as 60-mesh, 100-mesh, 200-mesh, etc., when designating a product required, without really meaning that 100 per cent. of the material must pass the designated size of screen. What is really meant is that a high percentage of the product should pass through the given mesh, such as 80 per cent. through 200-mesh, 95 per cent. through a 100-mesh, and 99.6 per cent. through a 60-mesh. Even the term 95 per cent. through 100-mesh has no absolute significance, since one might have two samples of material, each of which has been ground so that 95 per cent. will pass a 100-mesh sieve, but one of which is so uniformily ground that all will pass a 50-mesh, while the other would have some particles left on a 35-mesh sieve.

This shows that it is necessary when stating the fineness required, to state also the size and percentage of the largest particles. For example, in specifying the fineness of ground rock phosphate, if expressed as 95 per cent. through 100-mesh, the remaining 5 per cent. should practically all pass a 60-mesh. Unless the character of the coarser particles is considered it is not possible to compare the same material ground and separated by different processes.

Screen Limitations

The use of screens or screening cloth for separation of fine materials is limited to a comparatively coarse product. When very fine separation is attempted the screens soon clog, decreasing the capacity, and returning to the mill improperly cleaned tailings which contain a high percentage of fines, eventually choking the mill. When the tailings are rejected as in the case of hydrated lime, the attempt to make the separation by screens results in the loss of much of the hydrate. With hard abrasive material the screen openings are rapidly enlarged and soon give a product much coarser than desired.

Another disadvantage of screen separation of very fine materials is that an appreciable amount of moisture in the material will soon clog the screen openings, necessitating frequent cleaning.

Separating by Air

To avoid the above faults and be able to obtain a fine uniform product air separation must be resorted to. By air separation we mean genuine air separation and not air conduction. There are processes which use air to handle the ground product. In some of these the material is sucked out by a fan and in others the discharge passes to a mechanical separator instead of to screens.

A real air separator should be an integral part of the mill. It should be able to remove the ground material from the grinding surfaces just as fast as it is made, thus preventing the mill from clogging. This increases the capacity of the mill, as it permits the rolls to grind on coarser particles. This can only be accomplished by having the air enter underneath the grinding surfaces and blow the ground particles up and away from the rolls.

The separator should be dustless in operation. It should be able to maintain a uniform product irrespective of changes in air velocity or air density met with under operating conditions. Should it become necessary to change the fineness of the finished product, it should be so designed that this can be accomplished in a short time and without shutting down the equipment.

The Raymond System

Fig. 1 shows air inlet ports beneath the grinding chamber of a Raymond mill. Fig. 2 shows a view of a typical installation, a cross-section of which is shown in Fig. 3. In Fig. 2 it will be noted that after the material has been ground and separated it is drawn into the fan and then blown into a cyclone dust collector. The material after traveling in the comparatively small sectioned discharge pipe enters the large sectioned collector and is compelled to travel in a circular path; the centrifugal force thus produced causes the material to hug the walls of the collector and eventually drop through the bottom as finished pro-

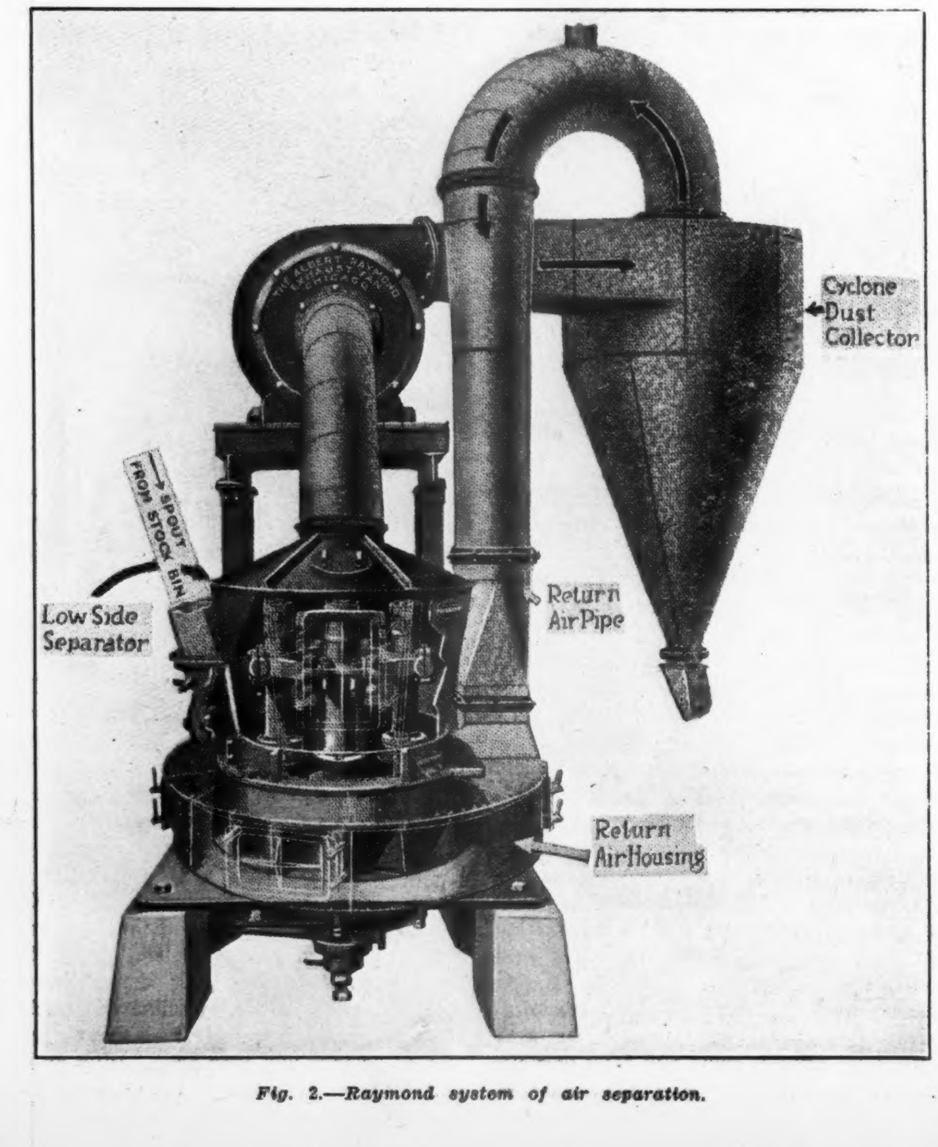


Fig. 2.—Raymond system of air separation.

*Engineer, Raymond Bros. Import Pulverizer Company, Chicago. Abstract from Rock Products.

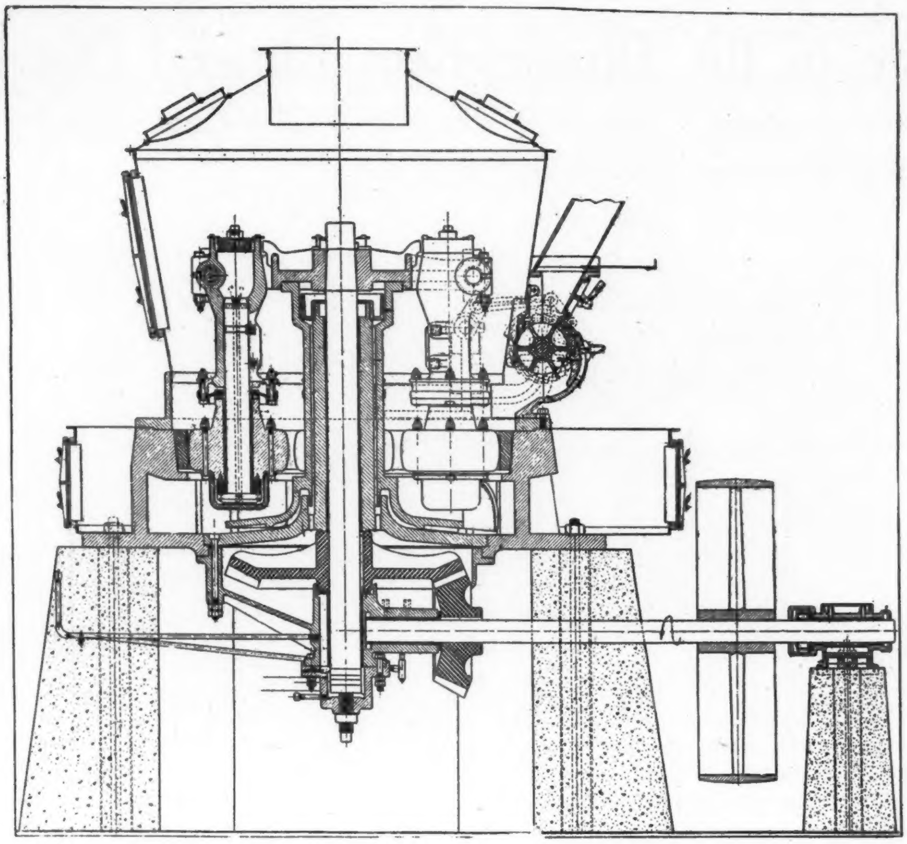


Fig. 3.—Section of mill and connections.

duct. The air being freed from the material passes up through the top of the collector into the return air pipe, which delivers the air back to the portholes under the grinding chamber, shown in Fig. 1. These ports are surrounded with an air-tight casing, as shown in Fig. 2.

Just as soon as the rolls pass over the material the air takes it away, lifting it up, at the same time imparting to the material a whirling or circular motion. As the material passes up with its cyclonic motion, the whirling currents travel in a larger and larger circular path, due to the increased radius of the separator, the coarser particles, due to the action of centrifugal force, are constantly being thrown against the sides of the separator and drop back to the mill to be reground, while the finer particles upon which the centrifugal force is not great enough to overcome the fan suction, pass into fan intake.

This type of separation is used with what is known as the low side mill (Fig. 3). It is adapted for medium grinding, that is, for material ground so that 85 to 95 per cent. passes through a 100-mesh sieve. It will be noticed that the separation obtained is not done by changing the air velocity or air density, but by imparting a circular motion to the particles, lifting them up with a cyclonic motion, and as the separator increases in diameter and the air increases in rarity the coarser particles keep on dropping back to be reground. We can thus safely use a high air velocity and lift up both coarse and fine, keeping the grinding surfaces free from fines and gradually, due to the cyclonic motion of the particles, separate the fine from the coarse and throw the coarse out of the air currents back to be reground.

For Finer Separation

When a still finer product is required, or where it is desirable to frequently change the fineness, the high side mill is used. The grinding mechanism of a high side mill is identical to that of a low side mill, the only difference being that in a high side mill a double cone separator is used, while in a low side mill the single cone is used. The material is ground and removed from grinding surfaces in a similar manner in both mills.

In the high side mill the material, after being subjected to the same mode of separation as in the low side mill, receives a further separation by passing the material up between two cones and into an inner cone where it receives any degree of separation desirable.

Applications of Air Separation

In the industrial field air separation has replaced all other methods where an extremely fine product is required, for it gives a much larger capacity than is possible by screening or bolting. In fact, the fineness of the finished product attainable by air separation is practically unlimited. A finer product can be obtained than from the finest silk bolting cloth, and at a fraction of the cost. The fineness of some materials that are being commercially separated today is greater than can be indicated by the finest testing sieves it is possible to make. When one realizes that there are screens on the market of 350 meshes to the linear inch, or 122,500 holes per square inch, some inkling is had of the fineness that can be attained in an air-separated product. The fineness of such materials can only be determined by a microscope and the mesh of the particles estimated.

Sticky materials, or materials that become sticky when handled can be readily obtained by air separation; such materials are resin, pitch, shellac and various gums used in making varnishes.

For pulverizing limestone, calcite, talc and other rocks and minerals for paint fillers, etc., air separation is the only practicable means, since the commercial requirements of such materials generally call for 200-mesh stuff or better. Many such products are ground to 350-mesh.

The use of air separation in conjunction with the pulverization of coal has given great impetus to the application of pulverized coal in many types of furnaces, particularly in the case of open-hearth steel furnaces. Although the requirements of a rotary cement or lime kiln do not call for a finely pulverized fuel, it has been proved that a purer product can be calcined because of the complete combustion and the absence of ash in the product, when using a 200-mesh fuel.

THE ENGINEER REPORTS A CASE OF EMERGENCY

THE FOLLOWING episode will be of exceptional interest to engineers familiar with the practice of making out reports. The author is an engineer employed by a large manufacturing corporation who was taken ill with appendicitis, and after surviving the customary rites guaranteed in such performance —the alienation of his appendix—despatched this account of the circumstances to the head of his department.

Dear Boss:

Arrived customer's plant Thursday the 13th. Spent day taking levels, running lines, establishing clearances, cleaning up, etc.

Friday the 14th., opened bottle of ether waves, experimented with same. Visited Mars, the moon, Venus, etc., while Master Mechanic and pipe fitters opened chest and looked for cracked fitting; finally found same and removed it.

Saturday the 15th., and Sunday the 16th., delayed account of trouble with pipe lines, etc.

Monday the 17th., started fires with light fuel and got steam turned on lines.

Tuesday the 18th.—General lining up, grouting, etc. Will operate on light load shortly, full load in about 10 days.

Work 35% completed.

Did not replace defective fitting.

"SHORTY" BAUMEISTER.

We are all pretty well agreed that "Activated Sludge" is not a closely descriptive or otherwise satisfactory designation of what it stands for. An English contemporary was so worked up about it that it actually offered a guinea (in depreciated sterling) for something better. The prize was awarded for the alternative title of "Forced Aeration Process" as the best suggested, although it applies only to the method and not at all to the product or result as "Activated Sludge" does.

Compressed Air Usage in the Birmingham Mineral District

Pig Iron Production Expected to Reach 2,500,000 Tons in 1920—Coal Mined in 1919 Estimated at 16,000,000 Tons

By Robert H. Cunningham

BIRMINGHAM, located in Jefferson County, Alabama, is justly termed the Magic City, due to the valuable mineral deposits underlying its surface.

Iron ore, coal and limestone, the principal supplies for steel manufacture are found in the district, a condition which is not found any other place in the world.

The climate is delightful; the winter season is short and mild, and the summers, while rather hot, are tempered by invigorating evening breezes, thereby enabling the industries of the district to maintain a very high efficiency throughout the year.

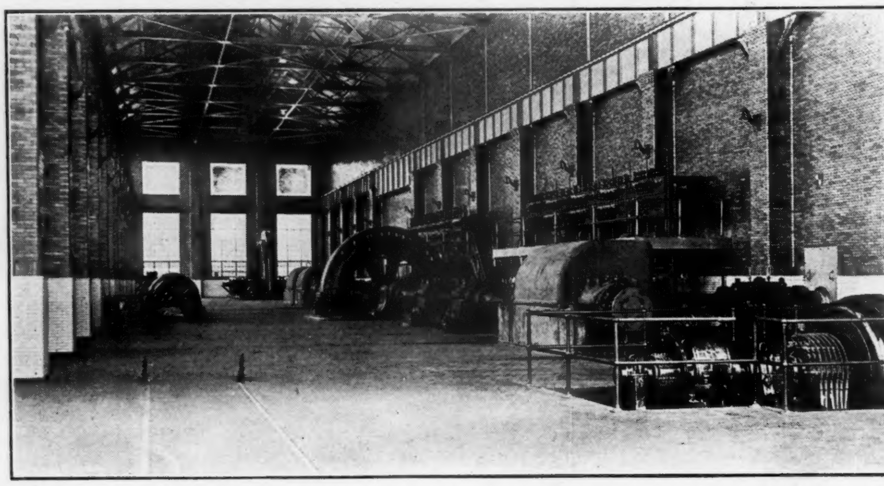
Birmingham is the youngest of the larger cities of the South and yet its population at present is over 200,000, and with its present rate of growth will undoubtedly, within a few years, be the Metropolis of the South as well as the largest shipping center of finished products.

The city is beautifully laid out with wide numbered streets and avenues, while the South Highlands section is a veritable park laid out along the slope of Red Mountain. On account of the many railroad tracks passing through the city and in order to eliminate grade crossings for the enormous city traffic, two viaducts have been constructed. One serves east and west traffic along First Avenue, while the other, known as Rainbow Viaduct, recently completed, serves north and south traffic along Twenty-First Street in the heart of the city. Its electric railway system is about 200 miles in total length. The water supply comes from the mountains to the southeast in abundant quantities and is most wholesome and free from contamination. The city and district are well supplied with electric power from a large hydro-electric plant of the Alabama Power Company on a nearby river.

Birmingham boasts of having the most extensive and numerous manufacturing establishments in the South, as there are 375 plants located there with upwards of half a billion dollars capital invested. Its finished products include steel of all kinds, cast iron pipe, machinery, coke by-products and cement.

The mineral output of the district is ever growing. Ninety per cent. of the iron ore mined in Alabama comes from there, which in 1919 amounted to a pig iron production of 2,109,546 tons from the 38 blast furnaces of the district. At this writing the monthly pig iron production should net a total yearly output well over 2,500,000 tons.

The estimated coal production for 1919 was 16,000,000 tons mined while the coke yield was around 3,750,000 tons. With the recent completion of two large coke by-product plants the yearly yield of coke will be larger and a greater revenue will be obtained due to the valuable by-products being retained in the more up-to-date methods employed.

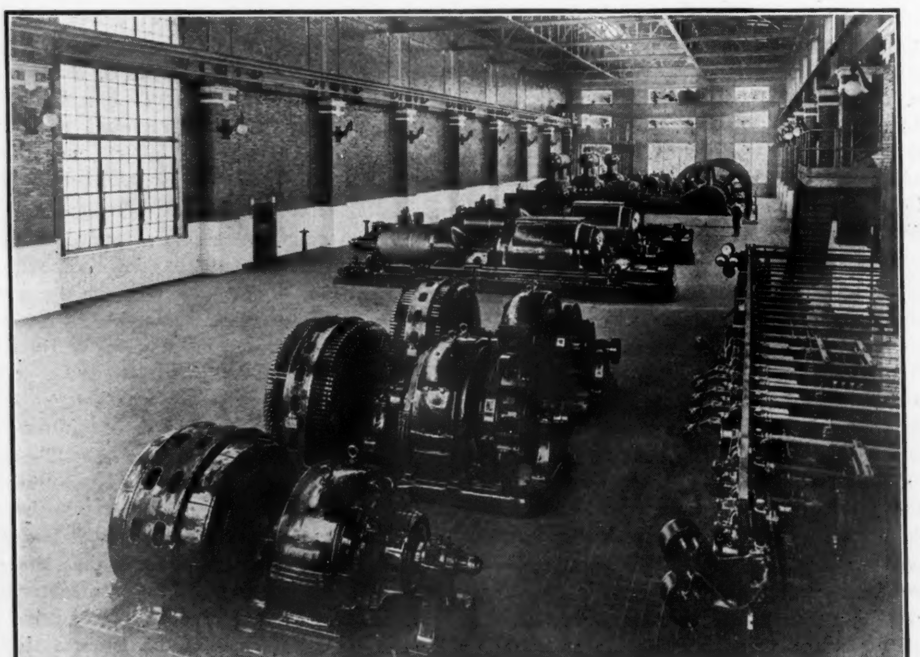


L-D motor driven structural mill at Fairfield plant, Tennessee Coal, Iron & Railroad Co.

The mineral tonnage of the Birmingham district is three times greater than the cotton crop of the entire South.

The iron ore mines are located along the north slope of Red Mountain, the outcrop appearing near the top and dipping down to the south. The principal vein runs from ten to 25 feet thick. At the mines at present are slopes but the shaft is becoming popular as the haul is getting greater and greater as the mines are being developed. The Gulf States Steel Company were the first to sink a shaft or 50° slope into the ore beyond Red Mountain and at present are only about 50 feet from self fluxing ore at a depth of about 2,800 feet. The Woodward Iron Company have just completed a shaft into the ore at their No. 4 Ore Mine which lies in the valley to the south of Red Mountain. This 22x14 ft. shaft is 1,350 feet deep, and has been put down in record time by the E. J. Longyear Company of Minneapolis, Minn.

There are in the district about one thousand air drills in daily use in the ore mines. A great number of piston drills are yet being used, these being mounted on tripods. The water type hammer drill is gaining favor but to date not a great number have been installed. The jackhamer unmounted is used in a great number of mines where the character



L-D. Power plant, Chickasaw Shipbuilding & Car Company showing Allis Chalmers motor generator sets, turbines and steam driven Ingersoll-Rand compressors.

Mining iron ore in the Birmingham district.

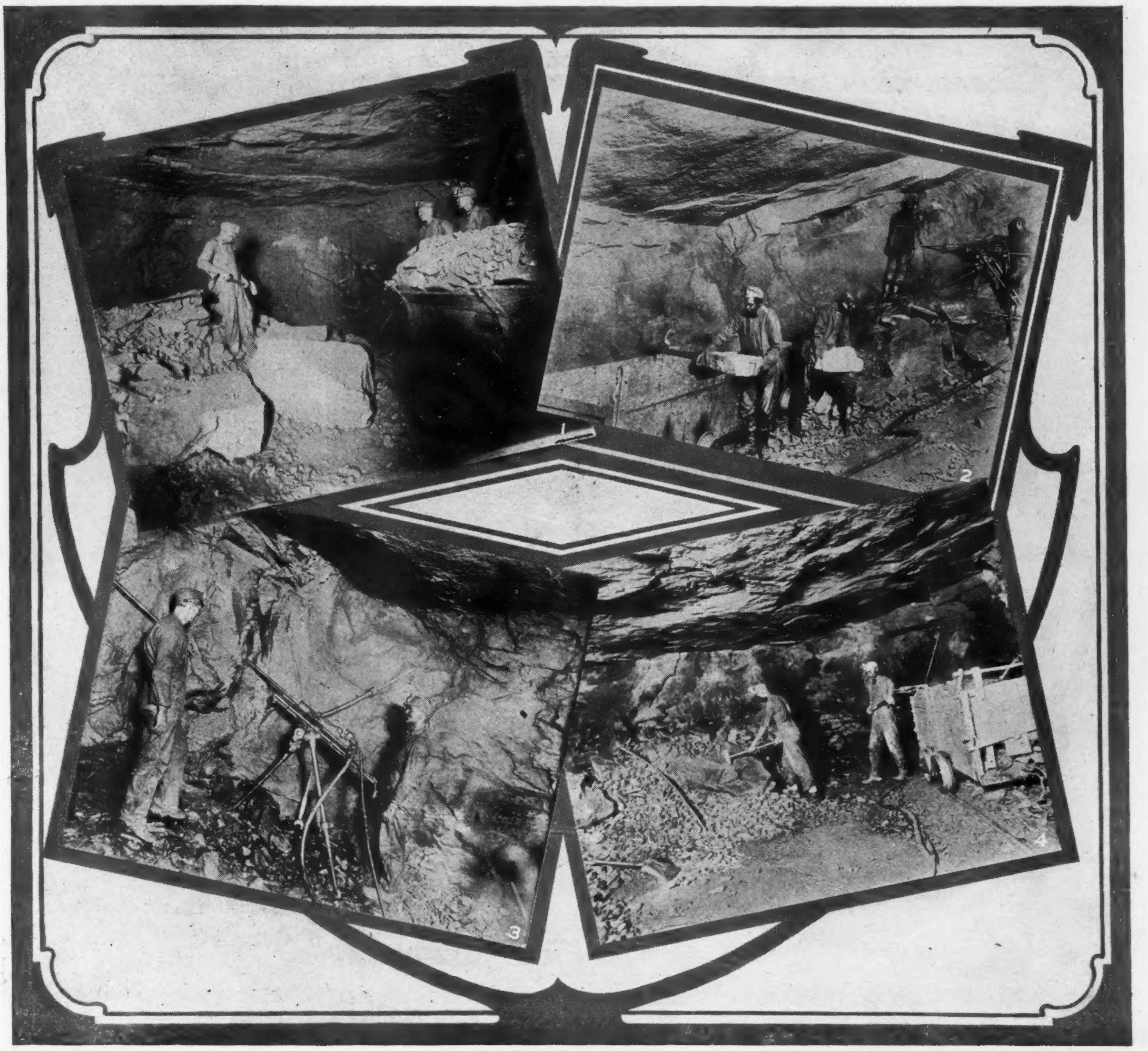


Fig. 1.—Spaulding mine—Republic Iron & Steel Company—Showing unmounted jackhamer and hand loading. Fig. 2.—Ore mining operation at Tennessee Coal, Iron & Railroad Company showing Piston drill mounted on a tripod, also the general appearance of the ore vein, and hand loading methods. Fig. 3.—Leyner-Ingersoll Water Drill Tripod mounted in Raimund Ore Mines—Republic Iron & Steel Co. Fig. 4.—Raimund Ore Mines—Republic Iron & Steel Co., showing one vein and manner of hand loading.

of the ore and the thickness of the vein justifies its use. One of the greatest problems with which the ore mines have to cope at present is the question of loading, and several different types of mechanical loaders are being tried out.

The Tennessee Coal, Iron & Railroad Company use principally the piston type of drill at this time and all mines are equipped with Leyner drill sharpeners.

The Republic Iron & Steel Company at their Raimund Mines use chiefly the water type hammer drill and their shop is equipped with a Leyner sharpener. The Spaulding Mine is equipped with jackhamers and Leyner drill sharpener, as well as Ingersoll-Rand compressors.

The Sloss-Sheffield Steel & Iron Company have their major operation at its Sloss mines and the equipment there includes Ingersoll-Rand compressors, Ingersoll piston drills and a Leyner sharpener. At this point a large Ingersoll-Rand air compressor is being installed to be operated electrically by power produced at a Central power station of the company at North Birmingham. At the Ruffner mines of the same company, jackhamers unmounted are used and their shop is equipped with a Leyner sharpener.

The Woodward Iron Company use piston drills and jackhamers and most of their shops are equipped with Leyner drill sharpeners.

The limestone deposits are mined from open quarries and piston drills and jackhamers are used principally to drill the ground.

The coal fields of the districts lie on the northern and southeastern side of the city and the vein is mined both by the drift and shaft method. A majority of the mines are electrically operated and a great deal of compressed air is used to operate coal punchers and jackhamers.

With the raw materials for the manufacture of steel so closely associated, it is quite natural that Birmingham should be one of the greatest manufacturing centres in the world.

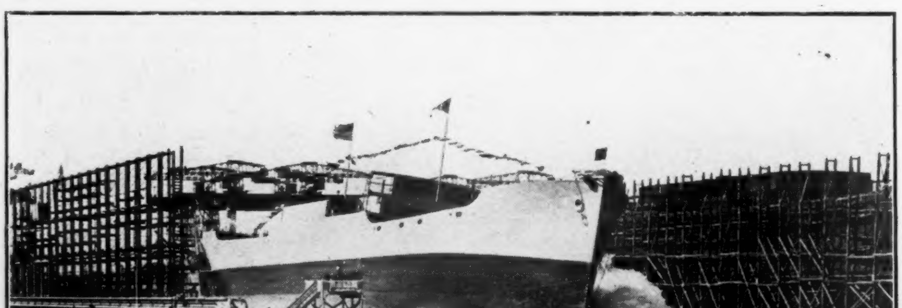
At Ensley, in Birmingham, is to be found the large mill of the Tennessee Coal, Iron & Railroad Company, subsidiary of the United States Steel Corporation. At this point is located its largest group of blast furnaces, six in number, openhearth, blooming and rail mills. The annual capacity of the openhearth

Birmingham as a Residential City.

Fig. 1.—The skyline of Birmingham. Fig. 2.—Birmingham's "Grand Canyon." Fig. 3.—Looking south through the centre of the city. Fig. 4.—The South Highlands residential section.

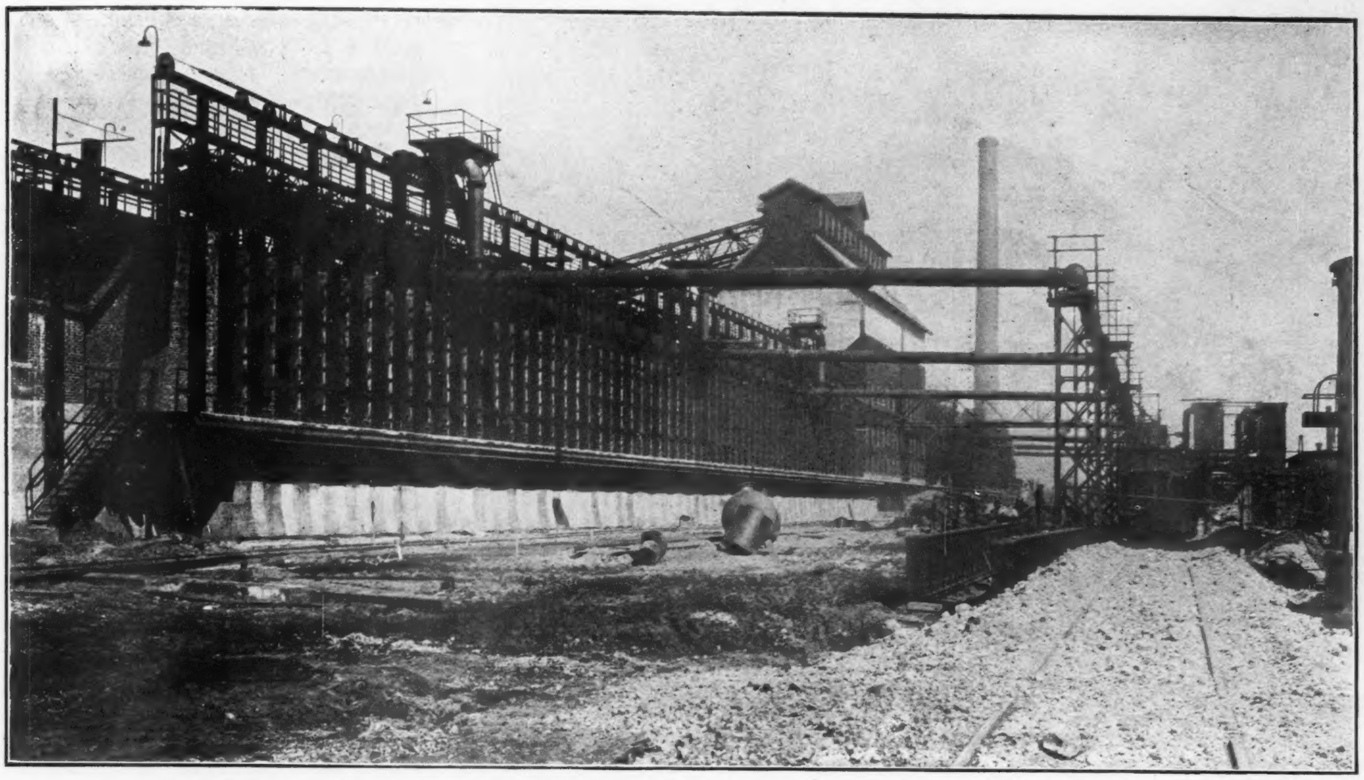
department is 750,000 tons. One of the blast furnaces just blown out for relining has been in continuous service for over eleven years showing a world's record production of nearly 1,500,000 tons. These blast furnaces are all blown with steam actuated units—reciprocating blowing tubs and turbo blowers. The first two turbo blowers manufactured by the Ingersoll-Rand Company have been in continuous operation at this plant for six years. Each machine has a capacity of 55,000 cubic feet of air per minute at a pressure of sixteen pounds.

Adjacent to Ensley is the Fairfield coke by-product plant of the same company producing 6,000 tons of coke per day, while a little further along down the valley is the plant of the American Steel and Wire Company, and further along is the newly completed plate and structural steel plant of the Tennessee Coal, Iron & Railroad Company which is turning out materials for the fabrication of ships at

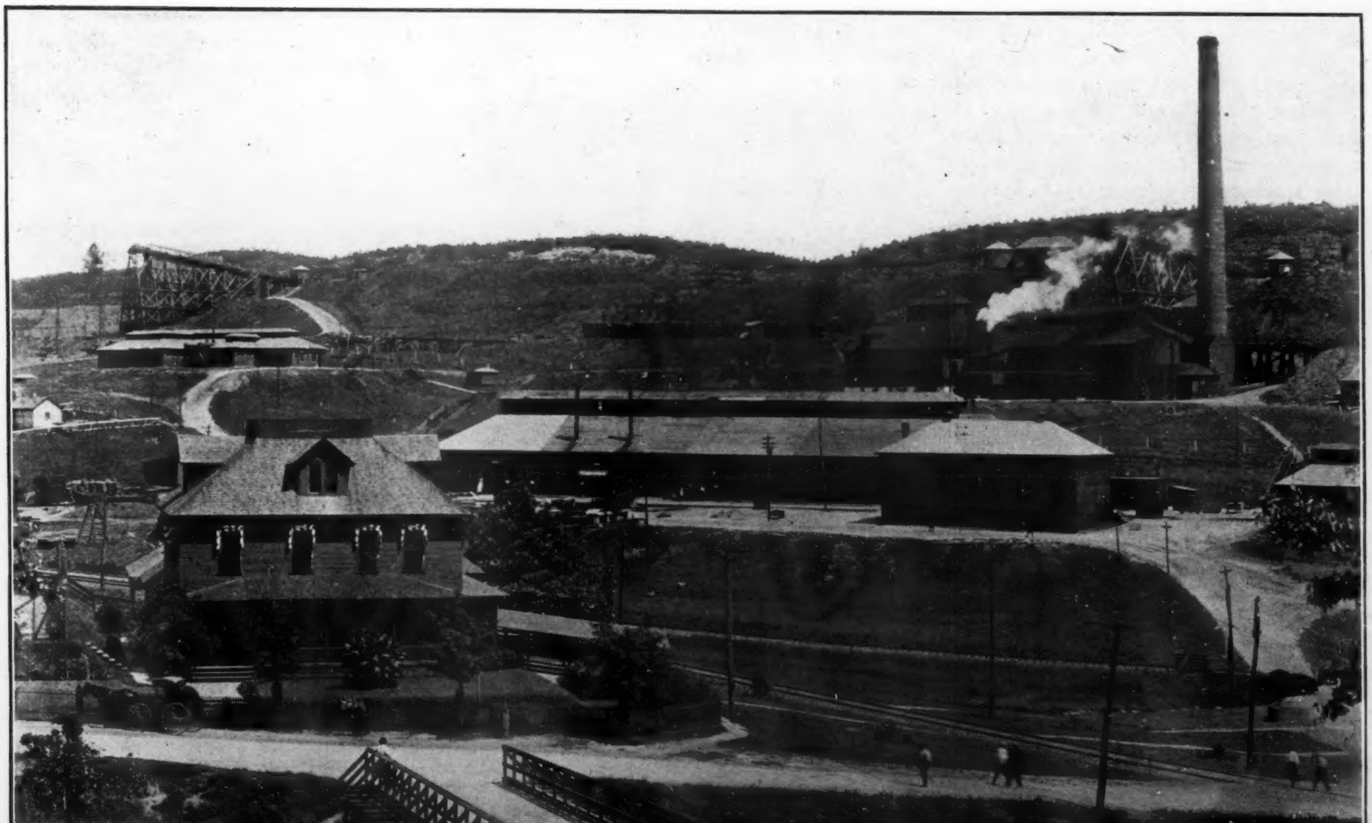


Launching of the first 9600-ton ship "Chickasaw City" at plant of the Chickasaw Shipbuilding & Car Co.

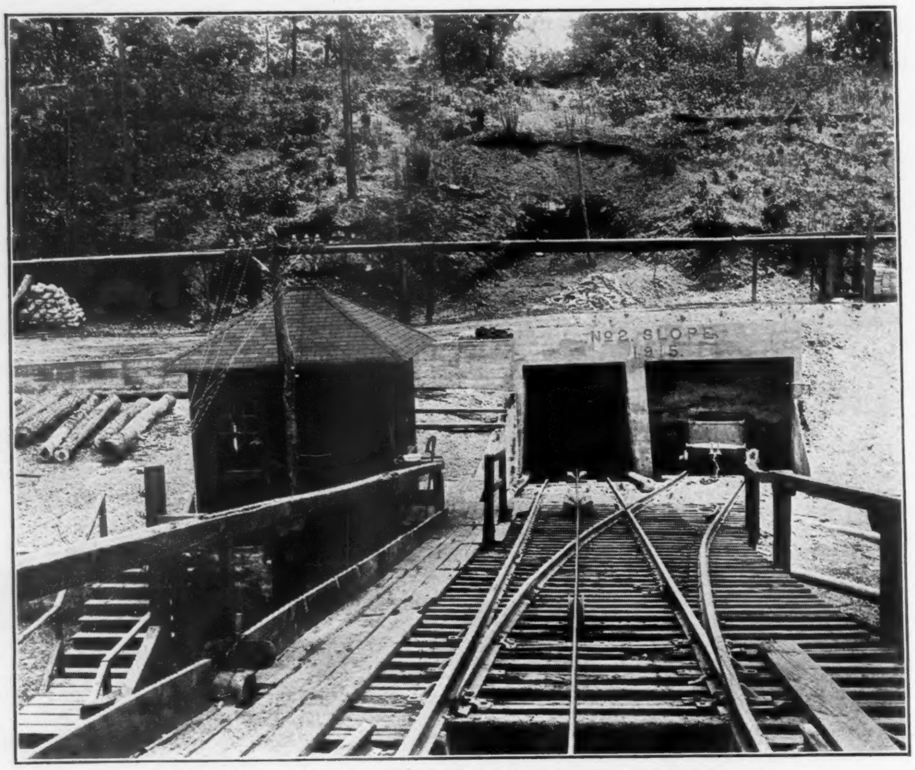
Industrial Views in the Birmingham District



General view of Semet Solvay coke by-product plant just completed by Sloss-Sheffield Steel & Iron Co.



Ore mines, Muscoda division—showing general arrangement of shops and plant.



Portal of No. 2 slope, Raimund Mines, Republic Iron & Steel Company.

Chickasaw Shipbuilding & Car Company located at the head of Mobile Bay near Mobile, Alabama.

The transportation of raw and finished products from Birmingham to the sea has been developed to such a point that a short rail haul of seventeen miles gives a water outlet to Mobile Bay by way of the Warrior River thus reducing the all rail freight rate by twenty per cent. With the raw material available in the district and the transportation so thoroughly worked out Birmingham is bidding for her share of world trade.

The Chickasaw Shipbuilding & Car Company, while located at Chickasaw near Mobile, is really closely connected with Birmingham as it receives all of its fabricated steel from the district via the Warrior River. This is the largest ship yard on the southern coast, in fact but few in the United States are more completely laid out. They have already launched from their six ways two 9,000-ton steel ships. Their contract covers ten of these ships, the programme calling for a launching every 30 days.

In laying out this plant a wonderful engineering feat was accomplished as the site was originally a virgin swamp. The whole plant is supported on piles and concrete. The power plant is the last word in refinement and is the best in the whole South. The main power plant consists of three 8,000-cu. ft. steam-driven Ingersoll-Rand air compressors, two Allis Chalmers turbine generators and three motor generator sets.

For proof of Birmingham's seriousness in soliciting export business the question of permanent docks is being considered near the head of Mobile Bay, these to be supplied by Warrior River shipments as well as all trunk railroads of the South, which touch that point. The effect of tide is very slight and would not hamper permanent docks, as it does at New Orleans and the distance to the sea is miles shorter than at New Orleans.

Birmingham looks to the future with optimism and her continued growth and prosperity is bound to make her proud of her wonderful resources.

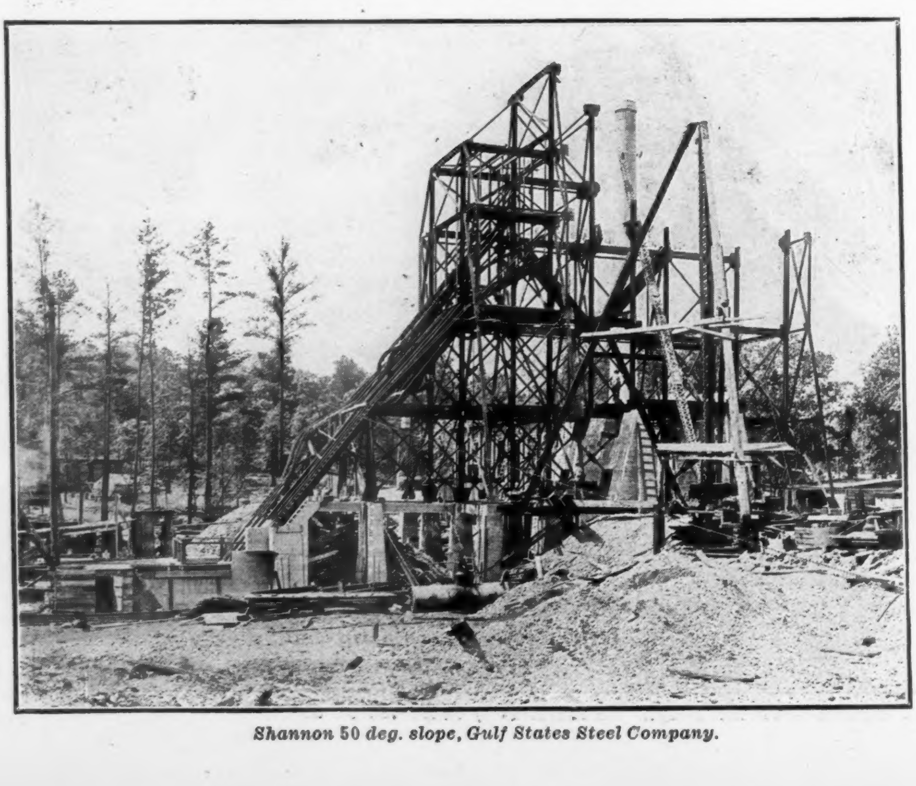
AIR MACHINERY EXPORTS

The Bureau of Foreign and Domestic Commerce has provided for publication the following table of exports from the United States of air compressing machinery, by countries, in the last month for which records are available, March, 1920.

Countries	*Dollars*
Belgium	8,070
Denmark	893
France	113,340
Italy	3,793
Netherlands	215
Norway	176
Portugal	1,922
Spain	13,699
Sweden	160
England	116,403
Canada	29,511
Costa Rica	1,702
Mexico	41,364
Barbados	1,582
Cuba	779
Dominican Republic	970
Argentina	7,372
Brazil	1,776
Chile	9,996
Colombia	65
British Guiana	150
Peru	1,226
Uruguay	64
British India	8,486
Dutch East Indies	1,095
Hongkong	260
Japan	155,017
Australia	11,054
New Zealand	390
Philippine Islands	14,849
Belgian Kongo	474
British South Africa	3,778
French Africa	3,046
Egypt	3,478
Total	557,155

NOVEL BLASTING SCHEME

A method of blasting a heading, possessing a new feature, is reported from the Nordhausen mining district in Germany. Instead of two or three inclined shot-holes in the centre to unkey the face of the work, the holes are bored parallel with the axis of the drift, locally known as "canon-shots." These are arranged and fired to make a hole of no great diameter in the centre of the face by crushing the rock. Then a ring of shot-holes is bored around this central opening and fired. This removes a considerable mass or rock, thereby greatly enlarging the central opening. Another ring of holes, more widely spaced, clears the face. The novelty consists in the close-together central crushing holes. Being so near together, it is not necessary to have a primer and fuse in each. The concussion of one shot in those circumstances is sufficient to fire the rest.



Shannon 50 deg. slope, Gulf States Steel Company.

John Hickey, 50 Years an Air Machinery Man

Half-Century of Service Celebrated by Fellow Employees—His Career Linked with Invention and Development of Rock Drill and the Air Compressor—Golden Anniversary of a Workman who Never Strikes, whose Philosophy is if You Stick to the Boss he will Stick to You

By Francis Judson Tietsort

JOHN HICKEY, still hearty and hale in his 74th year, celebrated a remarkable anniversary on June 2, when he completed a half century of service in the compressed air machinery industry for the Ingersoll-Rand Co. of New York. Few men are encountered these days in business that have served a single concern continuously and with fidelity for 50 years, and are still sticking on the job.

It was on June 2, 1870, that Mr. Hickey, a husky young chap, went to work for the Hydraulic Machine Company at their factory, 22nd Street and Second Avenue, New York City. In the following year, when the manufacture of rock drills just invented by the modest New England mechanic, Simon Ingersoll, began, the firm became known as Sergeant & Cullingworth. In 1886 the latter firm moved to Ninth Avenue and 27th Street. The concern subsequently became known as the Ingersoll Rock Drill Co., and somewhat later as the Ingersoll-Sergeant Drill Co. When merged with the Rand Drill Co. in 1905, the company took its present name, the Ingersoll-Rand Co. Throughout the changes of name and throughout the course of the great development in the company's business until it became the largest and most representative house of its kind in the world, John Hickey remained faithfully at work and is this day at his office, No. 11, Broadway, New York.

Mr. Hickey started in as a day workman and mechanic, but he showed ability and calibre and in due course of time in 1898, he became foreman of the compressor department of the company, progressing by stages through various departments. Since the joining of the Ingersoll and Rand companies fifteen years ago, he has been at the head offices of the company as an assistant office manager. It was in these offices on June 2 that Mr. Hickey was the recipient of unusual honors. Officers of the company, heads of departments, old associates and fellow employees to the number of several hundred gathered in the main corridors at an appointed time in the afternoon, all knowledge of the event having been kept secret until the astonished Hickey was summoned.

William L. Saunders, Chairman of the Board of the Ingersoll-Rand Co., addressed the gathering and paid a glowing tribute to so unusual a record of faithful service, later presenting to Mr. Hickey a beautifully engrossed memorial, illuminated in colors, prepared by an artist for the company, which was signed by the officers and scores of the employees. A check was also presented to Mr. Hickey as a further token of esteem. At the close of his address Mr. Saunders proposed three cheers and a tiger for the veteran, which

JOHN HICKEY, at 74, when interviewed by New York daily newspaper reporters on the occasion of the celebration of his fiftieth anniversary of service with the Ingersoll-Rand Co., made the following observations regarding the labor situation today:

"This attitude of labor is all wrong. Stick by your boss and he will stick by you. My experience has proved this. The men you work for will be fair to you if you play fair with them.

"The trouble with labor today is that all it thinks of is the time clock and the pay envelope. Labor is money crazy.

"I come to work an hour early to avoid the Subway rush and because I like to be on hand before the others.

"I've loved machines ever since I could walk. I've never earned a dollar in my life except by my work with machines. I feel toward 'em just the way a mother feels about her baby."

were given with enthusiasm, their recipient being greatly affected. There followed an impromptu reception, the employees filing past Mr. Hickey to clasp his hand and congratulate him.

In his address, Mr. Saunders called attention to the fact that the subject of the felicitations of the day had become connected with the machinery industry before the rock drill was a thing of practical appliance. As a matter of

JOHN HICKEY

From a portrait made on the day of the celebration.

fact, the Ingersoll rock drill was invented in 1871, and Hickey embarked on his career the year before. The Rand Drill Co. was organized in 1871, although prior to that time experiments had been made with rock drills, but the drill as a practical mechanism to supplant hand drilling followed Hickey's entry into the machinery industry.

In 1871, a plain mechanic, Simon Ingersoll, came to New York with models of some of his inventions. Mr. Ingersoll had a device, for instance, with which he could throw a line through a second-story window in case of fire, by means of a sort of pistol. He had several models of inventions of this sort, which he carried about with him. One day he was riding in a horse car—there were no trolley cars and few railroads at that time—and he was explaining one of these models to a man who sat beside him. On an opposite seat there sat John D. Minor, a prominent contractor who was interested in inventing a drill that could drill the rock on jobs where he was at work, and who listened to the man talking of his new patented device. When Mr. Ingersoll got through, Mr. Minor interrupted and inquired, as related by Mr. Saunders:

"Why don't you invent something worth while? For instance, why don't you contrive a rock drill operated by steam? I have a big contract here in New York and work in rock. You can readily see that drilling could be done much better by steam than by hand."

"I can do it. I'll go right to work—but I haven't much money," replied Ingersoll.

"How much money do you want?"

Ingersoll told him it might take as much as fifty dollars to make a model. Minor handed over to the stranger, who had an honest face, the fifty dollars, gave him his card and told him to go ahead. Mr. Ingersoll built the drill and he also went back to the contractor for several times fifty dollars.

Finally the drill was finished and taken to Mr. Minor's works. It worked a short time and broke the fronthead. It was then taken to Sergeant & Cullingworth's shop, where John Hickey was working at the time, and they were asked to make repairs. Mr. Sergeant, who was of a very inventive turn of mind himself, was in the shop when the repairing was being done and asked about the drill. Mr. Sergeant looked over the drill and said:

"The fronthead should not be a part of the cylinder. If one of these frontheads break, it should not destroy the cylinder."

And he took a saw and sawed the fronthead away from the cylinder on the pattern. Mr. Ingersoll came in while this was being done.

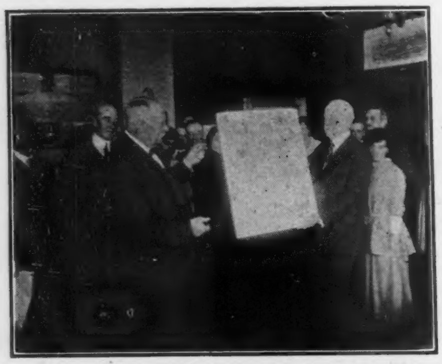
"Mr. Sergeant, what are you doing?"

"I am making this thing practical."

Mr. Ingersoll retorted: "That is my drill, not yours."

"But you don't know anything about machinery, and I do," argued Sergeant.

Mr. Sergeant finally induced Mr. J. F. de Navarro to buy Mr. Ingersoll out, and the work of Ingersoll and the rock drill was taken up and carried to a successful conclusion with a machine with which the whole world is now familiar. The Rand drill was developed about the same time, and the two concerns went along practically on parallel lines for a long period of years of progress and development. The Rand Company, at Port Henry, N. Y.,



William L. Saunders presenting the memorial to Mr. Hickey before a gathering of several hundred of his fellow employees.

and in the iron region of Michigan, and the Ingersoll, through John Hickey, did their work around New York where the drilling was done right under the eye of the shop man. Mr. Saunders went on to say:

"After the drill was perfected it became necessary to build an air compressor, and Hickey, the young Irishman, who at that time was tall and slim and full of vigor, was put at work on this new apparatus and the air compressor started its career as a standard machine. He was promoted to a foremanship. A foreman is very important, not only in the shop but in the industry, generally. The very word tells what the job means—the first man, and the foreman comes up from the ranks and gets the job by hard and faithful service. John Hickey rose to foreman because he did his work so well. Many times I have seen him in the shops with a monkey wrench in his hands, and it was not only on compressors that he used that wrench!

"Mr. Hickey oversaw the building of 1800 air compressors, the largest number of air compressors ever built in one shop. He still has a record of everyone of those compressors that he built, so you will see that he was something more than a mechanic. It was necessary to keep a record of exactly how each machine was built and how it had been tested, as we had no duplicate part system at that time. Mr. Hickey has that book today. When a breakdown did occur, and they did occasionally in spite of the fact that John Hickey built the compressors, he would turn to that little book and see exactly what kind of a valve or cylinder was needed.

"We are fortunate in having this man living and moving in our midst. It is a lesson for everyone of us, particularly the younger ones, and we should try to emulate the faithful service of this man."

Turning to the old foreman, the speaker then observed:

"John Hickey, in celebrating this fiftieth anniversary we want to tell you of our deep appreciation. It is a pleasure to do honor to you, to do justice to you. The company has given you a check, but we want to do something more than that which is represented by money. We want to express our esteem and our good wishes. We hope that you may live many years longer in happiness, health and prosperity.

"How blest is he who crowns in days like these
A youth of labor with an age of ease."

Mr. Hickey was somewhat overwhelmed, but arising from his chair, managed to say:

"I can say nothing else, but do wish to thank you and the company for all this. It is a very happy day for me."

Afterward Mr. Hickey was interviewed by reporters of the New York City daily newspapers.

Speaking of labor conditions, he declared with emphasis:

"This attitude of labor today is all wrong. Stick by your boss and he will stick by you. My experience has proved this. The men you work for will be fair to you if you play fair with them.

"The trouble with labor today is that all it thinks of is the time clock and the pay envelope. Labor is money crazy. Why, when I went to work, men were getting $2.60 for doing the same work that they get $7 a day for doing now.

"I would like to see anyone keep me from work every day. I live in East 50th Street, New York, with my daughters and my grandchildren, but I manage to get down here every day. I come early, at eight o'clock, to avoid the Subway rush, and then, too, I just sort of like to be on hand an hour before the others."

Speaking of his predilections for mechanics, he said:

"Why, I've loved machines ever since I could walk. I've never earned a dollar in my life except by my work with machines. I feel toward 'em just the way a mother feels about her baby. I couldn't bear to see one mistreated.

"I lived in Queens County, Ireland, until I was eight years old. My family wanted me to go to school, but I couldn't see it that way. All I could think about was machinery. My uncle was a jeweler, and wanted to take me into business with him. But I wanted to get into a shop. Finally, when I was thirteen, they let me go."

The Ingersoll-Rand Co., with the early beginnings of which John Hickey associated himself, has several other employees who have been with the organization for from 30 to 45 years, but Mr. Hickey is the only one as yet

1870 1920
THE INGERSOLL-RAND CO.
of New York
and the Officers thereof, and all fellow employees of
John Hickey
OFFER THEIR HEARTY GREETINGS AND THEIR CONGRATULATIONS ON THE OCCASION OF
THE FIFTIETH ANNIVERSARY
OF HIS ASSOCIATION WITH THE COMPANY
Which Began on June, the 2nd, 1870.

Because of so rare and praiseworthy a record of continuous duty, faithfully and cheerfully performed for a great industry, it is our pleasure to subscribe to this expression of GRATITUDE AND FELICITATION.

The Passing of this half century has witnessed the development of the most notable mechanical inventions in the world's history and the most notable achievements of science. To have played a part for so long in the production and improvement of compressed air machinery is an unique distinction.

By Direction of the Company, the officers of which, together with sundry fellow workers, have set beneath their signatures as attesting their deep appreciation of a lifetime of loyal and devoted service, this MEMORIAL has been engrossed for presentation to John Hickey, and copied into the Company's records.

Dated, June the 2nd 1920.
By
The Ingersoll-Rand Company

The memorial with the signatures of many of Mr. Hickey's associates.

that has celebrated his golden anniversary. Among the thousands of workmen at the company's half dozen factories are many who have been in harness a score of years or more.

GEORGE W. VAUGHAN DIES AFTER AN OPERATION

GEORGE W. VAUGHAN, who was the patentee of, and who in conjunction with W. H. Armstrong of the Ingersoll-Rand Co., was a developer of the Imperial tie-tamper, which is operated by compressed air and widely used on American railroads as a labor and time-saving device, died in the Mt. Vernon (N. Y.) Hospital on June 3, following an operation. Since 1906 he had been Engineer of Maintenance of Way for the New York Central Railroad's Lines East. He was one of the best known railway engineers in the East.

Born in Paucatuck, Conn., on November 11, 1859, his early education was obtained in the common schools. He embarked on railroading as a youth, but deserted the field for a time to become a draftsman for the Potter Printing Press Co. of Plainfield, N. J. He studied engineering and in time became construction and maintenance engineer for the Nickel Plate, where he remained for a number of years. Later he joined the New York Central engineering forces as supervisor of bridges and buildings, subsequently becoming division engineer on the Pennsylvania and western divisions. In 1906 he was promoted to the post of Engineer of Maintenance of Way with headquarters at New York, which post he held to his death. During practically all of his railroading career he was in the employ of the so-called Vanderbilt lines.

Mr. Vaughan made his home at No. 105, Lorraine Avenue, Mt. Vernon, N. Y. He left a widow and four children, Miss Dorothy, and George, James and Ralph Vaughan.

The funeral was held June 8, at two o'clock at Mr. Vaughan's late home. Many New York Central officials as well as co-workers of Mr. Vaughan attended the funeral, a special train taking the party from Mt. Vernon station to Kensico Cemetery, and bringing them back to New York after the services. The Rev. William H. Owen, Jr., rector of Trinity Church, Mount Vernon, officiated.

Mr. Vaughan was a member of the American Society of Civil Engineers.

SPEED AND ALTITUDE

As previously noted, an average speed of 155 m.p.h. was attained by a Bregnet airplane in a flight from Paris to Lyons. The high speed is attributed to the altitude maintained, varying between 17,000 and 20,000 feet. At sea level the speed of the machine is only 93 m.p.h. so that the altitude gave a gain of 66 per cent. It was not necessary during the flight for the pilot or his mechanician to use oxygen masks and by the aid of the Rateau turbine compressor the full engine power was maintained.

The experiment would seem to go far to warrant the prediction of Bregnet that with air tight cabins it would be possible to reach an altitude of 50,000 feet and to fly at a speed of 250 m.p.h. Even then the supreme wonder would be not in the speed but in the ability of such an attenuated atmosphere to sustain the weight of the machine.

Cures Diseases by Compressed Air

A compressed air hospital © International

In the exclusive residential district of Kansas City there has been built a long steel tank-like tunnel, 88 feet long and ten feet in diameter. The structure is the design of Dr. O. G. Cunningham, a Kansas City physician.

This steel tank encloses a chamber into which patients are confined for treatment by compressed air. The interior is fitted with Pullman sleeping equipment and accommodates 72 patients. Many local business men as well as patients from all parts of the country are taking the cure.

The length of this special treatment varies from three to twelve hours daily. A pressure of from five to twenty pounds a square inch, depending on the condition of the patient, is applied. The immediate effect of the treatment is an enormous stimulation of energy, a quieting of the nerves, an increase of appetite and restful sleep. See editorial in this issue.

TRACK SUPPLY MEN TO MEET AT ST. LOUIS IN AUGUST

The ninth annual exhibition and 38th annual convention of the Track Supply Association will be held from September 21st to the 24th, inclusive, at the Statler hotel, St. Louis. The exhibits are those of associated manufacturers of track appliances that are affiliated with the annual convention of the Roadmasters' and Maintenance of Way Association of America and Canada, which will be held simultaneously at St. Louis. Rooms will be available for the erection of exhibits on Saturday morning, September 18.

The president of the Track Supply Association is William H. Armstrong, manager of the tie-tamper department of the Ingersoll-Rand Co., No. 11, Broadway, New York, and the secretary-treasurer is W. C. Kidd, of the Ramapo Iron Works, Hillburn, N. Y.

THE NATIONAL MINE RESCUE CONTEST AT DENVER

A national first-aid and mine-rescue contest will be held August 20-21, at Denver under the auspices of the Bureau of Mines. Mining teams from the principal mining companies of the country will participate, and especially those teams of the West that were unable to attend the national meet held last year at Pittsburgh, Pa., in which over a hundred teams took part. The contest will be for the national championship in first-aid and mine-rescue work, honors which are coveted by every miners' team in the country. National contest cups, medals and prizes will be awarded to the winners.

Mining companies anywhere throughout the country who expect to enter are urged to get in touch with Mr. D. J. Parker, U. S. Bureau of Mines, Pittsburgh, Pa.

Notice to Readers

The January, 1920, issue of COMPRESSED AIR MAGAZINE is out of print, except for a very few file copies. The publishers will be glad to receive from friends any copies of the January number which are not being preserved for bound volumes. Kindly mail them to the attention of The Secretary, Compressed Air Magazine, Room 1216, Bowling Green Building, New York City.

According to a cablegram received by U. S. Department of Commerce from Commercial Attache Abbott at Tokyo, the banks in Japan are not considered in a precarious condition, with the exception of the 74th Bank of Japan which was forced to suspend business on May 24 for three weeks.

Compressed Air in the United Kingdom

By Roland H. Briggs
British Editorial Correspondent

STARTING AND REVERSING OIL AND GAS ENGINES

LITTLE MORE than a decade ago it was the duty of the writer to add his weight to that of other members of perspiring humanity to haul the gas engine flywheel up to the compression in starting, but much has happened since that time and practically no engines above about 23 b.h.p. are now sent out without some effective means of starting apparatus being supplied. In many and especially in the larger cases this takes the form of compressed air apparatus, but not by any means in all.

The direction in which compressed air is proving of the greatest value in this connection is in marine installations. It is now becoming regular practice on the west coast of Scotland for the oil-engine driven vessels to shut down their engines on entering port and to do all their manouevring, reversing and starting from their compressed air supply. In the "Gardner" vertical marine type oil engines a lever operated compression relief gear is fitted, so that engines up to 75 b.h.p. can, if desired, be started by hand, through a chain and sprocket gear with a free wheel and ratchet on the crank shaft, and bracket and detachable handle, but even with the smaller engines compressed air is often specified because of its convenience for manoeuvring.

With these engines the usual system is for a small air compressor to be installed on the baseplate of the main engine, from which it is belt driven, and the pressure used is 220 lbs. per sq. in.

With engines for land use, the methods of application of the compressed air are varied, and there are in addition several other methods of starting. A favorite starting device of some manufacturers is the hand pump, and although this is in itself in the nature of a hand-operated air compressor, it cannot be included in the category of normal compressed air starters.

With the "Crossley" hand pump starter the crankshaft is set at an angle of about 70 deg. on the impulse stroke, the barring gear disengaged, the magneto lever set so that it will trip as soon as the piston begins to move, the starter valve set to open when required, and the exhaust valve fixed open to allow the air in the cylinder to be replaced with another charge from the pump. The hand pump is then moved rapidly through the full range of stroke for several strokes, drawing in the gas and air and forcing them into the engine cylinder. The exhaust valve is then closed and the pumping continued until the piston moves, when the magneto will spark and ignite the charge that starts the engine. With producer gas, petrol or benzine is used with the hand pump instead of gas for the initial combustion.

The "National" gas engine also favors the hand pump method of starting, the principle being in general as explained above.

Coming to compressed air starters proper, a variety of systems are met with. In one case the momentum of the fly-wheel is used to compress sufficient air in a receiver connected with the engine cylinder after the fuel has been shut off to start up the engine again when required. A more usual and efficient application of the receiver storage system is the method in which part of the explosion pressure is taken through the control valve while the engine is running and stored in the accumulator up to about 150 lbs. pressure or more. The accumulator is made of such a size that sufficient air is stored at this pressure to start the engine several times.

In a more elementary form of this system, suitable for small or medium sized engines, the air is fed into a tubular receiver, and a hand pump is provided for filling the tube by hand in cases of emergency. In addition to these starters there is the most usual form employed, particularly with large engines, and that is the simplest and most certain and effective compressed air starter of all, the independent compressor. These compressors are designed for simplicity and of very small capacity, but they are capable of producing considerable pressures. In most cases they are only air cooled and are running—not compressing—whenever the engine is running, being driven from the engine shaft without a clutch or other knocking off gear. This is specially so with the marine engine type.

With the stationary engines the compressor is sometimes erected separately from the engine, and supplied with a fast and loose pulley or clutch, so that it need only be run as required. The writer has examined figures relating to the Gardner, Blackstone, Vickers, Campbell, National, Petters, Fielding and Crossley engines, of both gas and oil types, and finds that only in one instance is the starting air pressure quoted as low as 100 pounds per square inch, 150 pounds being more usual, and 200 pounds the pressure in the great majority of cases for engines over 40-50 b.h.p., with 220 for marine sets. The new 1,800 b.h.p. horizontal gas engines being constructed by Vickers at their Barrow works are started by compressed air at 300 pounds pressure.

Various arrangements of the independent compressor have been devised to suit different conditions. The small air compressor may be horizontal in design and direct coupled to a small kerosene or petrol engine, or it may be vertical with an extended raised bedplate on which an electric motor stands, which drives the compressor through gearing. Most of the compressors are air cooled, but the larger sizes may be water jacketed. The compressor may have an independent receiver, as is usual with larger compressed air systems, or may be a self contained unit, a hollow cast bell having a small reciprocating vertical compressor mounted on one side, and bearings at the top carrying the crank shaft, with the fast and loose pulleys overhung on the one side, and the crank overhung on the other. The pressure gauge, inlet from the compressor, and outlet to the engine, with their cocks, are all mounted on the one casting.

NOTES FROM SHIPBUILDING AND MINING CENTRES

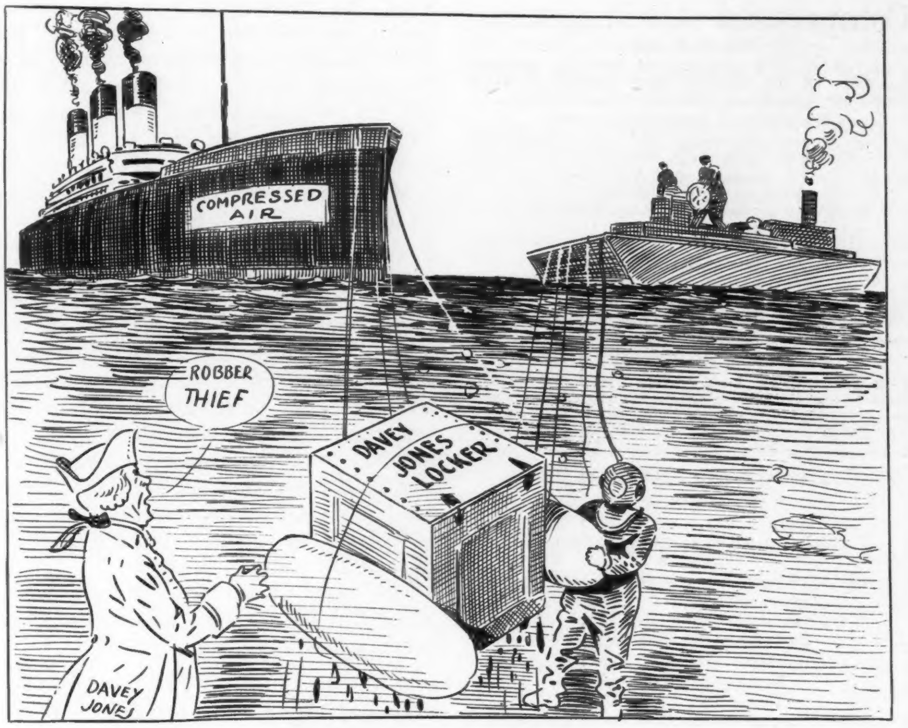
NEWCASTLE-ON-TYNE. Considerable use is now being made in the North East Coast shipbuilding areas of a method of closing up rivets on the shell or other parts of the ship which has not become general practice until the last month or two. By this method a heavy chipping hammer is used instead of the ordinary riveting hammer. The ordinary riveting hammer is taken inside the ship or tank, and a few blows are struck with this tool to close up the head of the rivet against the plate or plates to be riveted. Immediately this is done, the operator sets to on the outside and closes the rivets up, the operator on the inside again giving the rivet head a few blows just as the outside man is finishing. The result of this method has been very surprising, the strain on the workmen being much less than with previous practice. In several jobs seen and tested which had been carried out in this way, there were practically no spoiled or loose rivets.

MIDDLESBOROUGH. An innovation in the Middlesborough District is the use of compressed air to lift and lower a special bell or shield over the top of the charging bell or hopper of blast furnaces whilst they are being loaded. This method has just been introduced at a blast furnace, the mechanism consisting of a nine-inch cylinder with approximately a seven-foot stroke, the piston rod from the cylinder being attached to a rocking lever beam, and the bottom end of the cylinder being hinged to the super-structure of the blast furnace. As far as the writer has been able to ascertain, this is quite a new idea in this country, and it has a double value, it protects the workmen from the rush of flame and at the same time prevents the admission of cold air to the furnace when charging.

LIVERPOOL. It is generally understood in Great Britain that the American workman is strongly in favor of big production because it means for him big wages, and that he not only appreciates but actually demands the very latest mechanical equipment which can tend to reduce his labor or increase his output. That the reverse is too often the case in Great Britain is very clearly demonstrated by the following extract from the Liverpool *Echo*, although it also indicates that there are signs of a more progressive spirit amongst certain sections of the men.

"The National Amalgamated Union of Labour, 50 Branch, Mersey District, state that

at their general meeting a long discussion arose over the introduction of the mechanical scaling hammer in the Mersey district. This was disapproved of nine months ago by the men working in Harland and Wolff's, and has since been introduced, they state. The following resolution was carried unanimously: That this general meeting strongly condemns the action of the district delegate, also the district committee, in allowing the mechanical scaling hammer to be introduced in Cammell, Laird's, after the decision of Messrs. Harland and Wolff's men not to use it under any circumstances, and therefore resolve to take drastic action should the same be attempted on the Liverpool side."



THE MODERN WAY OF THWARTING A PERTURBED DAVY JONES

Notes of Industry

At a special meeting of the labor committee of the Industrial Monumental Granite Producers' Association held early in June, Orlando R. Smith, secretary of the committee, was instructed to sign for the committee with a committee of the Granite Cutters' International Association a recommendation to the members of the Producers' Association and to the members of the various branches of the union, that the Boston labor agreement be amended by providing that the rate of wages on and after June 14, 1920, be $1 per hour until April 1, 1922. The executive council of the union approved the amendment and communicated the action to the various branches by telegraph and telephone.

The Locke Slate Products Corporation, Fair Haven, Vermont, organized in Vermont for $50,000 will build a mill at Fair Haven to grind slate into granules for covering paper asphalt shingles for roofs.

Vermont Milbury Products Corporation organized in Massachusetts for $2,000,000 to manufacture slate granules for paper asphalt shingles, have purchased the mill of Mahar Bros. at Fair Haven, Vermont., and are preparing to build an additional large modern mill. The mill will cost $200,000. It is expected to have this mill completed by next September.

The Vermont Marble Co. is building a large modern steel building for a finishing mill for marble, to cost approximately $225,000. This mill will be equipped with 24 gangs of saws, twelve rubbing beds and enough polishing wheels to take care of the polished marble and will be modern, in every respect being equipped with all possible labor saving devices. There will be traveling cranes both outside and inside the building. These cranes will take the place of many large horses, which would be used to move the stone from place to place. This new building is not to take the place of the present plant, but is to be a new extension.

What is believed to be the world's largest cotton mill housed under one roof is to be built by the Aberthaw Construction Co., Boston, Mass., at Summersworth, N. H. The mill is to be built for the Great Falls Manufacturing Co., and when completed will be approximately 1,900 feet, more than a third of a mile in length, and 144 feet in width and either five or six stories in height. The estimated cost of the job is $7,500,000.

Cement-Gun Co., Inc., Allentown, Pa., announces the election of B. C. Collier, general manager, to be vice-president and general manager of the company. W. J. Roberts, president of the Traylor Engineering & Manufacturing Co., has also been advanced from the position of vice-president of the Cement Gun Co., Inc., to that of president, and S. W. Traylor, formerly president of the Cement Gun Co., is now chairman of the board of directors.

American National Expositions, Inc., announces that in compliance with the request of the American Chamber of Commerce in Buenos Aires, Argentine Republic, the proposed exhibition of American products which was to have been held in that city during March, 1921, has been advanced in date and will be held during November and December, 1920. Inquiries may be addressed in care of Julius Klein, U. S. Commercial Attaché, Buenos Aires, the Argentine, South America.

American Mining Congress announces that its twenty-third annual convention will be held at Denver, Col., during the week of November 15 next. There have been no Western sessions of the congress for a number of years, and a large and profitable meeting is expected. The convention will consist of a number of national conferences, arranged by special committees, and will include conferences on Federal Mine Taxation, Oil Shale, Coal and Petroleum, Uniform State Mine Taxation and other mining laws, and there will be special meetings of national gold producers, of Government and state mining and mining schools officials, and of mining machinery manufacturers. Details of organization and of programme are in charge of John T. Burns, assistant secretary, to be addressed at the Washington, D. C., headquarters of the Congress until the opening of the Denver office is announced.

Orders already have been placed for core room, molding machine and sandblast equipment to triple its output by the Monroe Steel Castings Co., Monroe, Mich. It will utilize present plant capacity and does not contemplate the erection of additions at present. It recently increased its capital from $100,000 to $300,000 and changed its practice from crucible to electric furnace.

In Sweden there were in operation, on March 31, 68 blast furnaces, against 81 the previous year; 85 Lancashire hearths, against 107; Bessemer furnaces 9, against 11; Martin furnaces 48, compared with 52; and electric and crucible furnaces 12, as against 5.

Arthur L. Hawkesworth, a mechanic for the Anaconda Copper Mining Co., has devised and patented a movable bit for drills which is designed for use with a shaft of cheaper-grade steel. The company is having a large quantity of these bits made, and, when they are received, the bit will be given a thorough trial to determine whether it is practical.

The American Smelting & Refining Co. has advised the Arizona Tax Commission that the Sasco smeltery at Sasco, Arizona, is being dismantled. The plant on a production basis was taxed on a valuation of $500,000. The owners now suggest $50,000 as an ample sum.

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Correspondence invited from engineers, chemists, experimenters, inventors, contractors and all others interested in the applications, practice and development of compressed air. Correspondents and contributors will please submit questions, or matter for publication, accompanied by self-addressed stamped envelope; they also will please preserve copies of drawings or manuscripts as we cannot guarantee to return unavailable contributions in the event of rejection, though our practice is to exercise diligence in doing so.

EDITORIALS

LOWER LIVING COSTS CAN BE BOUGHT—WITH ECONOMY

CLARENCE W. BARRON, the noted financial authority of Boston and New York, declares that there is no need for the industrial world, or the public in general, to worry over a "panic" in America for the reason that it has already come and gone in the last six months without the people knowing anything about it. He is also publicly quoted on the subject of what may be done, in his opinion, permanently to remove the causes of panic and the high cost of living, or the cost of "high living," his gospel being to economize, to save, and to buy government bonds. Prices started to drop this Spring because bankers told merchants they had reached the credit maximum, that they must empty their shelves and put the money back in the banks, while keeping their goods moving, and not in storage. Price-cutting came as a result not of an over-supply of goods, but of an under-supply of credit.

Whether prices will fall further in favor of the artisan, the industrian and the office-worker—in other words, the plain everyday citizen—depends wholly upon the people themselves. It is a question of fashion and sentiment. By economizing, says Mr. BARRON, the people may have almost anything they desire. There has been a sentimental boycott all over the country against exorbitant prices made possible by speculative storage of goods, which once more proves that all great reforms come from the common people.

Mr. BARRON declares that by simply cutting meat largely out of daily diet the people of the United States could save five billion dollars a year, that they could save another five billions by raising their own vegetables in backyards. But what will do the trick of lowering the costs of living for everybody will be, after economizing, to save and make investments of cash in government bonds. This will make goods abundant and cheap. The incentive for saving is that good bonds can be bought that will yield six per cent. Perfectly good railroad bonds have been selling so low as to yield the investor ten and twelve per cent. on the market price.

The moral of Mr. BARRON'S views is that lowered living costs may be had, but must be purchased with personal economy.

GERMAN EXCHANGE SHOWS INCREASING INDUSTRY

IN THE CURIOUS and complex gyrations of the foreign exchange market in the last half year, American manufacturers, exporters and bankers have watched the course of German marks with more than ordinary interest. One outstanding fact has been that while French francs were depreciating, exchange on Germany was improving. At the end of January the mark was quoted at one cent in New York. In March it gained half a cent and by the middle of April it had reached two cents. In May the quotation was still higher. There was one jump up to four cents.

There have been small but steady net gains up to this writing early in June, when the mark is quoted at 2.48 cents. The normal value of the mark in our currency is 23⅞ cents, of course, so that there still remains an abnormal depreciation, but it is notable that despite increased German paper issues of $1,750,000,000 since last December, there should have been a rise in German exchange and such sharp falls in French francs in the face of a moderate reduction of paper currency in France. German business men are now obtaining credits and raw materials in this country and German exports and imports are constantly increasing in a way to indicate that manufacturing in the old established industrial centres is about to pick up appreciably. International business is the great post-war healer. The British and French are now steadily trading with the late enemy, and America is doing likewise. The more rapidly Germany recuperates in her industries the better off all Europe will be in her distressed economic structure, for there are no boundary lines in the European economic fabric. All continental countries are inextricably intertwined in business, willy nilly, much as are our commonwealths in interstate commerce. Without respect to the conditions of the Peace, all sane thinking business men will be glad to note German commercial rehabilitation, for it will be a barometer of the general improvement in European business on which France, England, Belgium, Italy and the United States must depend in considerable measure for their hopes of restoration of international tranquility and surcease from social unrest.

FIFTY, AGE OF EFFICIENCY AND POISE IN MEN

THE GENERAL manager of a state territory for a large machinery concern sat at dinner one evening not long ago and discussed age and business efficiency. He argued, and he is nearer to 40 than 50, that the best years of a man's life lie beyond the half century mark, provided he takes reasonably good care of his mind and body. We were so impressed with his views that we had them set down on a paper for the benefit of our readers. In effect he said:

"If it were possible for me to live 100 years and remain at the same age for the entire period, I should set the mark at 50 years. I cannot imagine how any person would care to select his present age or a younger age unless he was without ambition, or had become embittered against life through some untoward event. This would mean the adoption of the Chinese adage, that 'the past is better than the present.' I am now 43 and feel no older than I did at 30, but I have obtained a fund of knowledge born of experience since I was 30, and expect to add materially to this in the next seven years.

"It seems to me that the period between 40 and 50 is the most important one in any person's life, as the mind should have reached that degree of maturity which enables its owner to logically size up any situation without needless delay. The benefits of education should be most potent at this period. We know that education is not a storage of facts; it is a training of the mind to analyze a problem correctly, and give the solution quickly. Dr. G. STANLEY HALL of Clark University once said, that 'Education is a multiplier to be used with the multiplicand, natural ability' and this product should be most effective at the stated period.

"At 50 I should still be able to play 36 holes of golf without fatigue, and even hope to have some degree of control over my wooden clubs. During the next seven years, I should add to my store of general information to such an extent that I will be more successful in business, and more interesting to those whom I meet socially.

"Between 43 and 50, I should make a careful study of myself. From a physical viewpoint, a man should realize that his body is a wonderfully complicated, but very efficient machine which is operated by his brain. If a person has driven an automobile for a year, he knows pretty well what that machine will stand. He knows how it will 'pick up,' how far he can trust the brakes and what grades of gasoline and lubricating oil give the best results. A man at 50 should know regarding the maximum efficient speed of his human motor, and should be conversant with every detail of its construction and upkeep.

"From a mental attitude, a man at 50 should

have learned his chief faults and made some progress in correcting them. I would liken habits to the books in a private library, and these should be subject to a continual weeding out process. The trash should be replaced by useful volumes. The trash includes over-indulgence of any kind, temper, indecision, selfishness and conceit, which should be replaced by temperance, serenity, determination, charity and self effacement.

"At 50, I hope to get more enjoyment out of life for myself, and to be able to help others do the same."

If beyond the 50 mark, how efficient are you?

COMPRESSED AIR HOSPITAL NEWEST HEALTH AID

OUR WONDERING and admiring attention is directed to a novel use for compressed air—that of its employment in a steel tank hospital, the patients being treated for various diseases and human ailments by air pressure. This compressed air hospital is the device of Dr. O. J. CUNNINGHAM, of Kansas City, Mo. It bears no relation, of course, to the air compartments used for curing the "bends," suffered by sandhogs employed in subaqeous tunnel driving when they leave multi-atmospheric pressures too rapidly.

Doctor CUNNINGHAM explains his now well-advertised new departure as having been based upon more than a year of experiments with a small tank at Bell Memorial Hospital, under direction of the University of Kansas. His car-like tank in the yard of the old Barton home at No. 3310, Harrison Street, Kansas City, is 88 feet long, ten feet in diameter, and is made of half-inch steel plates, which surely ought to hold all the pressure any patient could stand. It is divided into 36 compartments on each side of a hall.

Two types of diseases are treated in the tank, Doctor CUNNINGHAM explains. First, those due to the presence of anaerobic germs, germs which cannot live in oxygen, which are said to respond to the introduction of more oxygen into the lungs by increased air pressure. Under that head come neuritis, certain forms of rheumatism and pernicious anaemia.

Each of the compartments is fitted with a bed and standard sleeping car equipment supplied by the Pullman Company. It has shower baths, wash rooms, dressing rooms and four clothes closets. The cost of the tank and equipment was $50,000, Doctor CUNNINGHAM has announced.

The other types of disease which have been treated successfully, according to Doctor CUNNINGHAM, include high blood pressure, gout and acidosis. They are diseases due to the presence of irritating substances in the blood, according to Doctor CUNNINGHAM. The increasing of the amount of oxygen in the blood increases oxidation, which is similar to slow combustion, and eliminates these toxins from the blood, the theory is.

The treatments will vary from three hours to twelve hours and the air pressure used from five pounds to twenty pounds to the square inch. Seventy-two patients can be treated in the tank in the day, Doctor CUNNINGHAM says. Thirty-six patients will be treated at night while they sleep in the tank, so that the regular routine of their business in the day will not be interrupted. Although the erection of the tank was kept secret as far as possible, Doctor CUNNINGHAM says he had applications from more than 100 patients for admittance during the first week of treatments.

Patients undergoing treatment in the tank are conscious of no pressure except a slight pushing in the middle ear when the air first is turned on, Doctor CUNNINGHAM asserts. After five minutes in the tank that sensation passes, he says, and patients may read or amuse themselves as they desire.

On another page in this issue there appears a photograph of Doctor CUNNINGHAM's unusual hospital. Many business men and patients from all parts of the country are said to be taking the "cure." The immediate effect of the treatment is reported to be an enormous stimulation of energy, a quieting of the nerves, an increase of appetite and restful sleep. By means of the treatment, it is related, proven cures have been made in cases of neuritis, rheumatism, heart disease, high blood pressure, gout, hookworm, paralysis and other diseases arising from the activity of the anerobic germ in the human system.

If the compressed air hospital treatment gives these beneficial results, other similar equipments should be instituted at once elsewhere, in order that sufferers from lowered animation in the hurly burly of our modern life may be helped. From all accounts Doctor CUNNINGHAM is heartily to be congratulated on the success of his extraordinary efforts.

MINES BUREAU LOSES OLD AND VALUED EXPERT

DR. VAN H. MANNING, Director of the Bureau of Mines, Department of the Interior, resigned on June 1 to accept a post as director of research with the recently organized American Petroleum Institute, which is regarded as the most important body of petroleum men in the United States. Doctor MANNING had served the Department of the Interior faithfully for 34 years in which time he labored for his government with unswerving fidelity. He has borne a reputation for the strictest integrity and for having a high regard for the ethics of such a responsible post. He treated friend and stranger alike, declining to stultify himself by granting favors to one that could not be enjoyed by others. As a result great confidence was reposed in him by successive administrations, regardless of political considerations, and he has numbered among his admirers representatives of many industries, great and small. In addressing his resignation to President WILSON, Doctor MANNING took final occasion to urge more adequate compensation for scientific and technical men in government service, so that fewer able men (like himself) shall feel compelled to leave that service for more highly paid private employment. "Many of these scientific men," he said, "are of fine type for government work; care little for the commercial field; take an intense professional interest in their tasks and are of inestimable value to the government."

Doctor MANNING's statement is axiomatically true and its force is no doubt fully felt by the President. Righting the salary conditions as they apply to professional and technical men seems to be as difficult a matter as that of fixing and obtaining proper pay and quarters for our diplomatic and consular corps or for the skilled representatives abroad of the Department of Commerce. Persistent appeals to the Congress may some day have effect. Meantime hundreds of highly skilled government employees are nothing short of heroes, to say nothing of the trained men and women of the great postoffice department, whose imperative needs are crying.

As for Doctor MANNING, whom we salute as an old friend of COMPRESSED AIR MAGAZINE, we wish him joy and good fortune in his new post and many more years of helpful activity in the field he has chosen to adorn.

A. I. M. E. TO MEET IN THE LAKE SUPERIOR DISTRICT

THE AMERICAN INSTITUTE of Mining and Metallurgical Engineers will hold its Lake Superior meeting August 23-28, and the itinerary will include trips to Houghton, Ishpeming, Minneapolis, and Duluth, and thence on to Hibbing and the Mesaba Range. Sessions will also be held for the discussion of industrial and technical problems. This recent announcement is of importance not alone to mining men and metallurgists but to business men, manufacturers, and those engaged either directly or indirectly with production of minerals or their products.

The part played by such organizations as the Institute and their influence upon the direction of the industrial methods of the nation, is becoming more and more appreciated. It has become the general custom among the larger companies to send several of their experts and executives in charge of operations to these meetings. The larger copper, iron and zinc mining and smelting companies have been, for a number of years, usually well represented both by visitors and by men who actually arrange for and conduct these meetings.

The value of such intercourse between men occupying positions involving responsibility for the carrying on of operations on a large scale, with the stimulation of ideas and resultant inspiration to accomplish more in the field of production, are the incentives for their presence.

Certainly, the deliberations of such bodies represent the best thought each in its representative field, because of the opportunities this class of men enjoy of being at the very roots of economic, engineering and social problems. It is gratifying to recall that not only the technical press, but also many of the large metropolitan dailies throughout the country, commented editorially upon the discussions and recommendations of last year's St. Louis meeting of the A. I. M. E.

Particularly was this true of the discussions of social and welfare problems. Incidentally, as representative of this class of work, the present low accident rate in mechanical operations is largely owing to the coöperation between these national engineering societies. This indicates that the reports of the standing com-

mittees of such bodies are becoming popularly recognized as the leading thought based on wide experience in its special field. The American Institute of Mining and Metallurgical Engineers is a very useful and competent organization and it is to be congratulated that it possesses the machinery successfully to conduct such meetings.

The editors are pleased to announce to readers the appointment of Mr. ROLAND H. BRIGGS, of London, as British editorial correspondent of this journal. Mr. Briggs, an engineer and writer who is quite familiar with compressed air and pneumatic practice in the United Kingdom, has had a considerable experience in the air machinery field. He will chronicle in these columns from month to month activities in the British Isles pertinent to the scope of this periodical which will be of interest to users of compressed air on both sides of the Atlantic.

A newspaper of Yonkers, N. Y., the *Daily News,* declared that "appreciation of art is one of the strongest safeguards against materialism." The editor declares: "When all of us begin thinking of progress in terms of smoking factory chimneys and never in terms of sunsets and tree-arched streets, we shall be in a bad way. Art flourishes only as it is appreciated." True for you, in a degree, Yonkers *News,* but do not lose sight of the fact that the smoking chimneys in one end of town usually pay for the art both indoors and out of doors at the other end of town. And the man toiling where the chimneys belch smoke is probably very keenly alive to the beauties of the sunset and of the elms in front of the art museum. Business men that seek new industries for a town for the sake of "progress" are usually as keenly alert to aesthetic enjoyment as they are alive to the possibilities of larger revenues in trade. Look up the names of the men in your town who have made the art museum, parks and pretty avenues possible and you are apt to find that they are the men who put your town on the industrial map.

The fourth article of the series by Mr. JACQUES S. NEGRU of New York, on *The Technology of Air as a Power Medium,* having to do with the hot air engine, will be published in the August issue of COMPRESSED AIR MAGAZINE. Subsequent forthcoming articles in the series are to cover compressed air machinery and practical applications of compressed air.

The neighboring and closely related commonwealths of New York and New Jersey are now proceeding with the enterprise of constructing a vehicular tunnel beneath the Hudson to connect Manhattan Island with Jersey City, the former State having authorized a preliminary appropriation of $1,000,000 to begin the work. A discussion of alternative engineering methods of driving the bore was contained in this journal in last month's issue. By whatever method the engineering experts decide to construct this tunnel, the more quickly it is completed the better off the metropolis of the nation will be. For shifting freight to and from points directly west, that is, across the Hudson, New York, the world's largest city, is dependent entirely upon ferry boats and lighters, which are subject to the vagaries of weather and of labor. It will probably appear to us in years to come as incomprehensible that the Hudson had not long ago been tunnelled for vehicles and also bridged with a mighty structure to provide for traffic that will surely outstrip the capacity of the tunnel now to be built.

Following all the demagogic discussion anent the alleged vast overcapitalization of America's railroad companies, and their paying out dividends on "watered stock," reports have been made to the Interstate Commerce Commission by experts to the effect that the roads are, on the contrary, under-capitalized to the amount of at least two billions. By fair assessment, we read, their actual intrinsic value is more than these two billions of dollars in excess of their capital stock, and more than six billions of dollars in excess of the present market value of all their stocks and bonds! The highly pertinent query is raised whether, if those who have been shouting for the Plumb (or is plum?) Plan, or some other form of government ownership, were in a way to get their wish, they would be willing to have Uncle Sam pay the railways for their properties the trifling sum of two billions more than the face value, or six billions more than the market value of all their securities.

The following correspondence tells its own story with reference to the article entitled *"Style" in Professional Correspondence of Engineers,* which appeared in a recent issue:

Prof. P. B. McDONALD,

COMPRESSED AIR MAGAZINE, New York.

Dear sir:—

Your article on the best use of words and phrases in letterwriting in the April issue of COMPRESSED AIR MAGAZINE is very good. One question arises regarding the example on Page 9625. Is not the following sentence equally smooth English, and preferable because more condensed?

"I seek opportunity for advancement by changing to a larger concern."

Yours truly,

C. M. SPALDING.

Erie, Pa.

The sentence suggested by Mr. SPALDING is not so good as the one given in the article because the order of ideas is not so natural. He talks of "opportunity for advancement" before "changing." The sentence recommended mentions the ideas in this order: "change," "larger company," "chance for advancement," which is a more logical approach to the argument. The sentence in full was:

"I wish a change because with a larger company my chance for advancement would be better."

Also "company" is a better word than "concern."

P. B. McDONALD.

The board of governors of the Material Handling Machinery Manufacturers Association recently appointed the chairman and personnel of the main engineering committee and the six following sub-committees; cranes, hoists and winches; gravity and power conveyors; elevators; industrial trucks; bulk handling machinery; and miscellaneous equipment. There is a representative from each member company of the society on one of these sub-committees. The chairman of the main engineering committee is F. W. Hall, commercial manager, Sprague Electric Works of the General Electric Co., New York.

WHITFIELD PRICE PRESSINGER, vice president and general manager of the Chicago Pneumatic Tool Co. of New York, who had been with the concern since boyhood, died on June 10 at the Roosevelt hospital in his 49th year. He was regarded as an authority on compressed air and was a protegé of CHARLES M. SCHWAB, who was one of the honorary pall-bearers at the funeral. Mr. PRESSINGER was a member of the Lawyer's, the New York Athletic, the New York and the Railroad clubs.

Contents for July

Book Reviews

THE MODERN DEVELOPMENT OF HIGH-SPEED TOOL STEEL, a company treatise on the subject issued by Messrs. Sir W. G. Armstrong, Whitworth & Co., Ltd., Openshaw, Manchester, England. Illustrated with photographs and drawings, and containing tables of tests.

THE WELL KNOWN English house of Sir W. G. Armstrong, Whitworth & Co., Ltd., has issued a most commendable little volume on the subject of high-speed tool steels, which American makers and users of such products may do well to peruse. The booklet loses none in interest or in value because the company's own products are described in its pages; besides it contains an excellent essay on the historical and general aspects of steel and steel tools. The tests recorded also furnish interesting comparative data.

The treatise indicates that tools are as foundation stones upon which our complex modern civilization rests, for it is due to the fact that from time immemorial man has made use of tools that he has risen above brute intelligence to a dominating spiritual position. Before the dawn of the historical eras the problem of a suitable material for tools occupied the attention of the tribal sages, and our museums show the gradual advance from wood to flint, from flint to bronze, onwards to steel, which resulted from their efforts.

Archaeologists have shown that the crucible method of steel manufacture is by far the oldest process known, it being impossible, however, accurately to trace its origin and early developments. It would nevertheless appear certain that crucible steel was made and used thousands of years ago for cutting tools. What is regarded as proof of this may be seen in the marvellous carvings and work on the monuments of the ancients, the stone which is so intensely hard as to have withstood the erosive effects of centuries. It is difficult to conceive, then, by what means other than with steel tools such work could have been executed, and it is with wonder that one contemplates the fact that the principle of manufacture, namely by the fusion of iron and charcoal in crusibles, was in its essentials probably the same as the present-day process. The Chinese were undoubtedly makers of crucible steel long before the Christian era, whilst a celebrated steel was made in India centuries ago under the name of "wootz."

The famous Damascus steel, produced as far back as A. D. 1200, was famed among the Crusaders and for many years after for the purpose of weapons and armor. Curiously enough, the book points out, this steel furnishes yet another proof of the old adage that "there is nothing new under the sun," for it has been established that Damascus steel contained certain percentages of tungsten and chromium, which elements are also incorporated in modern high-speed steels. From this it is evident that a latent high-speed steel has been in existence for at least 700 years and there is only lacked a better knowledge of its proper heat treatment to develop and bring it to its present high degree of efficiency.

It is generally accepted that the iron first used for tools was of meteoric origin, and there is sufficient evidence on record to prove that the tools used in building the great Pyramids were made of meteoric iron-nickel alloy. It can, therefore, be believed that in prehistoric times iron was to a small extent obtained from meteors, and that from such iron tools of sorts were produced. A more reliable theory, however, is that the accidental melting many centuries ago of a pure iron-oxide with charcoal caused the first discovery and usage on any scale of iron for the purpose of tools.

For a long period there was little or no development in the manufacture of tool steel, which was produced by either of two processes:

(1) The welding together of bars of carbonised or cemeted bar iron to produce shear steel.

(2) The fusion of cemented bar iron, or a mixture of bar iron and charcoal, with the addition of oxide of manganese and spiegeleisen in crucibles—the product known as cast steel.

Many of the alloys used in the present-day tool-steel were practically unknown sixty years ago, and the first great stride in the development of tool steel was made in 1857, when Robert Mushet introduced his self-hardening or tungsten steel, capable of cutting harder material at higher speeds than were possible with carbon steels.

For 40 years self-hardening steel was developed and used all over the world, and then, by accident or otherwise, it was found that by raising the temperature of a self-hardening tool to a yellow heat, such a tool gave greater cutting efficiency than a normal one.

The credit for the development by heat treatment of self-hardening steels is given in the book to Messrs. Taylor & White, who introduced, at the Paris Exhibition in 1900, their wonderful high-speed steel.

Since that time countless experiments have been made, and there has been a gradual development in the cutting efficiency of such steels, due to the fact that combinations of the rarer metals with tungsten and chromium have been investigated and developed. The introduction of new elements into the composition of high-speed steel has opened up a wide and fruitful field of research.

The tool steels of to-day may be generally classified as carbon or water-hardening steels and tungsten or air-hardening steels, high-speed steel being the modern development of the latter group. In the manufacture of high-grade tool steels, the materials must be of the finest quality, and especially must the tungsten and iron be free from impurities, such as phosphorus and sulphur, if the best grade of steel is to be produced. Notwithstanding statements which are sometimes made, it may be asserted here that it is an impossibility to produce good tool steel from inferior material. There is an old and very wise adage amongst crucible steel smelters, namely, that "if you put the devil into the pot, you will most assuredly get His Satanic Majesty out of it again." At the same time, our authority notes, even when the best of materials is used, steel of inferior quality may result unless great care and skill are exercised by men who have become highly experienced in its metallurgical treatment.

OPPORTUNITIES IN ENGINEERING, by CHARLES M. HORTON. One of the series of "Opportunity Books." Price, $1. New York: Messrs. Harper & Brothers.

THIS PLEASANT and readable little volume from Mr. Horton's pen can be perused by any busy engineer in an hour or two—mayhap when he is dashing from one city to another "on a job,"—and for the young, enthusiastic man in the game it may open up some new mental vistas.

Engineering is a field that offers a career of unusual fascination to the young man of imagination. Mr. Horton points out its openings and the way to go after them—both by the overalls route and through the right kind of technical training. Mr. Horton, of course, is himself a consulting engineer of many years' experience, and his observations may command ready acceptance.

A WORLD REMAKING, OR PEACE FINANCE, by CLARENCE W. BARRON, author of *War Finance, The Mexican Problem, The Audacious War,* etc. Price, $1.75 net. New York: Messrs. Harper & Brothers.

HERE IS A KEEN analysis of the world situation today, in which the author, an internationally known student of finance, reveals the dramatic role played by money, from vast expenditures in propaganda to subtle manipulation in international credit. The keyword to the great problems of reconstruction is—money. The book shows that problems of the moment, from the Russian situation to international competition in shoes, or machinery, are problems of finance.

Mr. Barron, like other deep students, has discovered that the great truism of life on this sphere is that the happiness of peoples is bound indissolubly with sound economics and that a false economic basis for a people makes for a nation that the rest of the world must watch and reckon with. The Hebrew is celebrated for his personal scheme of economics in dealing with the necessities of life. Nations must be the same. In his foreword Mr. Barron observes:

"All history is bound up in the human problems of personal and national finance—personal and national protection to daily subsistence."

Mr. Barron goes on to tell what the vital problems of today are, and he discusses them from the vantage ground of "inside information." No person pretending to keep abreast of world currents today should fail to read this absorbing book.

THE WESTINGHOUSE E-T AIR BRAKE INSTRUCTION POCKET BOOK, by W. W. WOOD, Air Brake Instructor, author of *The Walschaert Locomotive Valve Gear, Locomotive Break-downs,* etc. Illustrated with colored plates. Second edition revised. Price, $2.50. New York: The Norman W. Henley Publishing Co.

THIS VERY complete work explains in detail the improved Westinghouse locomotive air brake equipment, including both the No. 5 and the standard No. 6 styles, with recent modifications. It contains examination questions and answers covering what the E-T

equipment is and how it should be operated, besides telling what to do in case of defects. It is declared that not a question can be asked of the engineman up for promotion on either the No. 5 or the No. 6 equipment that is not asked and answered in this handy volume.

The plate illustrations show the various pressures of air which assist the reader in understanding the effect produced in the various phases of locomotive and train brake operation. The book is, as the name implies, a textbook on the E-T locomotive brake equipment; therefore, the accessories that are the same as used in connection with the common, automatic engine-and-tender brake, such as air pump, train air-signalling equipment and foundation brake-gear, are not included.

The illustrations are wholly original, the scheme of giving each zone of air pressure its distinctive color causing the plates to appear self-explanatory to a great extent. The book is especially commended to travelling engineers, air brake inspectors and instructors, and it is obviously of great value to the student.

HOW TO USE CEMENT FOR CONCRETE CONSTRUCTION, by H. COLIN CAMPBELL, C. E., Director, Editorial and Advertising Bureau, Portland Cement Association. Including formulae, drawings and specific instructions to enable the reader to construct farm and town equipment. Illustrated with photographs and drawings. Price, $2. Chicago: Messrs. Stanton & Van Vliet.

THIS VOLUME comprises the most complete and the most valuable treatise on the subject that we have ever seen. It will become a standard work in the hands of every worker in concrete for it is virtually indispensable. It explains how concrete is made, and formulae are also given for computing the quantities of the different materials required for specific purposes so that in erecting structures no surplus material may be left on hand.

Detailed instructions are given on how to make the forms, set them up and how to proceed in building houses, foundations, floors, walls, porches and steps, sidewalks, garages, fence posts, barns, pig-pens and hog-wallows, milk houses, fruit and vegetable cellars, poultry houses, feeding floors, silos, septic tanks, troughs and many other structures where cement and concrete can be used. Accompanying those instructions are 250 drawings and photographs which enable the builder to clearly follow the instructions given.

The author, H. Colin Campbell, is recognized as the highest authority in America on cement and concrete construction. As an expert engineer who had made a special study of concrete, he was for many years in the service of the government. He is a member of the staff of the Portland Cement Association, being Director of the Editorial and Advertising Bureau, and in this capacity he has had unusual opportunities to obtain the most authentic information on the subject, having had access to all the files and records of the association and taken part in their various experiments and tests.

He has contributed numerous articles on cement and concrete to many technical and farm magazines and he is universally consulted as the most prominent expert along this line. Himself the owner and operator of a large farm, he has erected many of the concrete structures described in his book. To farmers who desire to have modern, fire and storm proof buildings this book is indispensable and it is of inestimable value to all who are interested in cement and concrete construction.

ENGINEERING APPLICATIONS OF HIGHER MATHEMATICS, by V. KARAPETOFF. In five parts and volumes. First edition, second impression, corrected. Price of set, $3.50. New York: Messrs. John Wiley & Sons.

PROFESSOR KARAPETOFF tells his readers pretty promptly in introducing his valuable work to their attention that it is not a work on calculus, nor yet analytic geometry (the market is flooded with them, he notes); nor is this a work on engineering or any branch of it. So much for what it isn't. The book *is* intended to enable an engineer to make better and more extended use of higher mathematics in his work.

The pioneer work of John Perry, the noted British engineer and educator, *Calculus for Engineers*, and the so-called "Perry Movement," will forever remain important monuments in the history of engineering education. Like many other pioneer books of the sort, however, Perry's *Calculus* proved to possess some defects when used as a regular textbook.

Karapetoff's book differs from that of Perry and his followers in two respects; i. e., first, an elementary knowledge of analytics and calculus is presupposed, and second, the arrangement of the chapters is according to engineering topics and not according to the mathematical functions or operations. The following are uses for the book, and for such it is highly to be commended:

(a) As a problem book in connection with a regular course in analytics and calculus. (b) As a textbook in a supplementary course (after the completion of a brief course in calculus) taught in the department of mathematics for the purpose of fixing the mathematical operations in the mind of the student and preparing him for the engineering subjects. (c) As a textbook in a course in engineering mathematics, taught in the junior or in the senior year by an engineer, to illustrate the methods of engineering research and analysis. (d) As a text or reference book in a *seminar* for graduate students in engineering. Most of these men come to college with a knowledge of calculus which is anything but good, and consequently are handicapped in their research and in understanding the literature of the subject upon which they are working. (e) As a study book for teachers in engineering and for practicing engineers, who require mathematics in their work and feel that they need a "brushing up" in order to be able to follow intelligently books, magazines, and transactions of engineering societies.

JOURNAL OF THE IRON AND STEEL INSTITUTE (British) 1919. Edited by GEORGE C. LLOYD, Secretary. Published by the Institute, London, and by Messrs. E. & F. Spon, Ltd. and by Messrs. Spon & Chamberlain, New York.

THIS VOLUME marks the centenary issue of the *Journal of the Iron & Steel Institute*, and contains the report of the proceedings at the last Autumn Meeting held in London, together with the papers presented on that occasion, and the discussions and correspondence to which they gave rise. The book will be of its customary value to both British-American workers in iron and steel, besides having the sentimental value of the centenary attached to it.

The reports and papers on fuel economy were discussed conjointly, and this procedure was likewise adopted in regard to the group of papers dealing with nickel chrome and nickel steels.

Obituary notices of distinguished members of the Institute, whose deaths have been reported to the Council recently, have been inserted in the present volume in accordance with the custom which obtained before the war, but which had for some years been discontinued.

New Mining Publications

THE BUREAU OF MINES of the Department of the Interior has published the following new bulletins and technical papers:

Bulletin 78. Approved explosion-proof coal-cutting equipment, by L. C. Isley and E. J. Gleim. 1920. 52 pp., 18 pls., 3 figs.

Bulletin 196. Coal-mine fatalities in the United States during the year 1919, compiled by A. H. Fay. 1920. 86 pp.

Technical Paper 227. The determination of mercury, by C. M. Bouton and L. H. Duschak. 1920. 41 pp., 2 pls., 1 fig.

Technical Paper 232. Absorption as applied to recovery of gasoline left in residual gas from compression plants, by W. P. Dykema and Roy O. Neal. 1920. 43 pp., 6 pls., 10 figs.

Technical Paper 240. Boiler and furnace testing, prepared by Rufus T. Strohm. Reprint of Bulletin 1, United States Fuel Administration. 1920. 23 pp., 3 figs.

Technical Paper 256. Accidents at metallurgical works in the United States during the calendar year 1918, compiled by A. H. Fay. 1920. 23 pp.

Technical Paper 257. Waste and correct use of natural gas in the home, by Samuel S. Wyer. 1920. 23 pp., 7 figs.

Bulletin 183. Abstracts of current decisions on mines and mining, reported from May to August, 1919, by J. W. Thompson. 1920. 167 pp.

Technical Paper 241. Blowholes, porosity, and unsoundness in aluminum-alloy castings, by R. J. Anderson. 1920. 34 pp., 5 pls., 1 fig.

Technical Paper 245. Quarry accidents in the United States, during the calendar year 1918, by A. H. Fay. 1920. 52 pp.

Technical Paper 250. Metal-mine accounting, by C. B. Holmes. 1920. 63 pp.

Technical Paper 252. Metal-mine accidents in the United States, during the calendar year 1918, with supplemental labor and accident tables for the years 1911 to 1918, inclusive, compiled by A. H. Fay. 1920. 113 pp.

NOTE.—Only a limited supply of these publications is available for free distribution, and applicants are asked to cooperate in insuring an equitable distribution by selecting publications that are of especial interest. Requests for all papers can not be granted. Publications should be ordered by number and title. Applications should be addressed to the Director of the Bureau of Mines, Washington, D. C.

Latest U. S. Patents

APRIL 27

1,338,008. VACUUM FUEL-FEED DEVICE. John E. Genn, Chicago, Ill.
1,338,030. TUNNEL AND METHOD OF EXCAVATING. James C. Meem, Brooklyn, N. Y.
1,338,137. AIR-DRILL. George Juresisin, Wilkes-Barre, Pa.
1,338,190. VALVE FOR AIR-BRAKES. Carl A. Nelson, Moline, Ill.
1,338,259. IMPACT-ENGINE. William A. Smith, Denver, Colo.
1,338,302. FLUID-BRAKE FOR MOTOR-VEHICLES. Frederik G. Hultenheim, San Francisco, Calif.
1,338,323. FUEL-FEEDING DEVICE FOR VEHICLES AND AIRPLANES. William H. Muzzy, Chicago, Ill.
1,338,337. AUTOMATIC PNEUMATIC, PNEUMATIC-TIRE-INFLATING MECHANISM. Arthur W. Stonestreet, Pasadena, Calif.
1,338,454. FLUID-PRESSURE APPARATUS FOR BURNING POWDERED FUEL. Patrick A. Leonard, Michael F. Maloney and Ernest Fandrich, Schenectady, N. Y.
1,338,466. ROTARY BLOWER. Ira H. Spencer, West Hartford, Conn.
1,338,604. GLASS SHAPING OR BLOWING MACHINE. Arthur Wilzin, St. Ouen, France.
1,338,651. PNEUMATIC CARD-CLEANING APPARATUS. William H. Goldsmith, Jr., Quincy, Mass.

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1,338,679. FUEL-BURNER. Neville C. Davison, Edgeworth, Pa.
1,338,711. TIRE-PUMP. Huston Taylor, Detroit, Mich.
1,338,732. REVERSING MECHANISM FOR FLUID-ENGINES. Francis A. Jimerson, Athens, Pa.
1,338,798. COMBINATION TRUCK AND WAGON DUMP. Fred W. Swanson, Des Moines, Iowa.
1,338,882. AIR-OPENER FOR DOORS. Joe Szczurek, Chicago, Ill.
1,338,896. FLUID-PRESSURE CIRCUIT-CLOSER. Thomas E. Brazeal, Maitland, W. Va.
1,338,923. CONTROLLING COMBUSTION BY FLOW AND PRESSURE. John M. Hopwood, Dormont, Pa.
1,339,098. DUPLEX-ACTING PERCUSSIVE BOILER-TUBE CLEANER. William Burlingham, Newport News, Va.
1,339,137. AIR-LIFT APPARATUS. Edwin M. Rogers, New York, N. Y.
1,339,182. PNEUMATIC LINT-CLEARER FOR WARPING-MACHINES. James E. Farrell, New Bedford, Mass.
1,339,224. PNEUMATIC PUMP. Homer S. Rogers, Milwaukee, Wis.
1,339,311. PUMP AND COMPRESSOR. Jean Zwickey, South Tottenham, England.

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1,339,382. SPRAYING APPARATUS. Herman Barber, Elwood, Ind.
1,339,402. CONDENSING AND VACUUM PUMP. Samuel Lippert, East Cleveland, Ohio.
1,339,510. AIR BLOWER AND DISTRIBUTER. William A. Hoffman, Dayton, Ohio.
1,339,540. OILER FOR AIR-COMPRESSORS. Emma C. Barchard, Chicago, Ill.
1,339,565. PNEUMATIC DRILL. Zephirin Lambert, Grand Mere, Canada.
1,339,594. AUTOMATIC LOCKING DEVICE FOR PNEUMATIC-TUBE SYSTEMS. George F. Botscheider, San Francisco, Calif.
1,339,631. APPARATUS FOR RAISING LIQUIDS FROM DEEP WELLS. Joseph A. Hebert, Freeport, Tex.
1,329,671. POWER-OPERATED MECHANISM FOR MOVING DOORS OR THE LIKE. Harold Rowntree, Kenilworth, Ill.
1,339,678. COMBINED VACUUM AND COMPRESSED-AIR BRAKE. Walter V. Turner, Wilkinsburg, Pa.
1,339,962. AIR-BRAKE SYSTEM. George Macloskie, Erie, Pa.
1,339,977. CONTAINER FOR COMMINUTED MATERIAL. Harry B. Pruden, Chicago, Ill.
1. The combination with a storage tank for comminuted material, of a discharge pipe leading from the tank, means for supplying air to the material in planes oblique to its path of travel, and means to produce siphonic action in the pipe and a partial vacuum in the tank.
1,340,017. PNEUMATIC ACTION FOR MUSICAL INSTRUMENTS. William C. Collignon, Chicago, Ill.

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1,340,196. PNEUMATIC RIVETING-HAMMER. John Howard Way, Philadelphia, Pa.
1,340,210. AIR-PROPELLER. Vendel Lazzlo Bekefi, Cleveland, Ohio.
1,340,233. HYDROPNEUMATIC DEVICE. Richard Liebau, New Haven, Conn.
1,340,366. GLASS-WORKING MACHINE. Alvah L. Bingham, Munice, Ind.
1,340,433. ATOMIZER. John H. Beynon, Ontario, Calif.
1,340,505. ROCK-DRILL. William A. Smith, Denver, Colo.
1,340,606. GRAIN-ELEVATOR. Dick Groenewold, Kiel, Okla.
1,340,689. GUN FOR DISCHARGING PROJECTILES BY GASES SUPPLIED THERETO UNDER PRESSURE. Tom Thornycroft and John Edward Thornycroft, Westminster, England.
1,340,728. SANDING DEVICE. Percival W. Miles, Wilkes-Barre, Pa.
1,340,758. SOAP-BUBBLE DEVICE. Michael G. Dobbins, Philadelphia, Pa.
1,340,820. AIR-HOSE COUPLING. Clarence M. Brown, Minden, La.

MAY 25

1,340,921. APPARATUS FOR TREATING AND CANNING MILK. Burt E. Taylor, Mount Vernon, N. Y.
1,340,939. RELATIVE-HUMIDITY-CONTROLLING MEANS. Clifford A. Cutler, Buffalo, N. Y.
1,341,010. INJECTOR OR EJECTOR. Ernest O. Cartwright, Springfield, Ohio.
1,341,236. MEANS FOR PREVENTING CLOGGING OF SAND-PIPES. George Henry Johnson, Hattiesburg, Miss.
1,341,260. AIR CONTROL. Henry M. Cheek, Ferndale, Ark.
1,341,319. AUTOMATIC VALVE-REGULATOR. Charles H. Hodges, New York, N. Y.
1,341,405. AIR-DRYING APPARATUS. John H. Woodard, Spokane, Wash.
1,341,430. PORTABLE COW-MILKER. William M. Mehring, Keymar, Md.
1,341,447. LIQUID-DISTRIBUTING SYSTEM. William A. Timm, Berwyn, Ill.
1,341,460. AIR-PUMP. Erwin Greisbaum, St. Louis, Mo.
1,341,515. FUEL-SUPPLY SYSTEM. Morris Parnes, New York, N. Y.
1,341,531. AUTOMOBILE AIR-BRAKE. Chester T. Alexander, Victoria, British Columbia, Canada.
1,341,536. BLOWER ATTACHMENT FOR DRILLS. Raymond Borcherdt, Naturita, Colo.

"HERMAN FRASCH" LAUNCHED AT NEWBURGH YARDS

A TWIN screw steel vessel of special design and unusual type was launched recently by the Newburgh Shipyards, Inc., of Newburgh, New York, for the account of the Union Sulphur Company of New York, and christened *Herman Frasch* by Mrs. Henry D. Whiton, wife of the president of the Union Sulphur Company, in honor of her father the founder of the company.

As the vessel commenced to move down the ways, six aerial bombs were fired from the deck and the bursting of those bombs some two hundred feet in the air released three United States flags and three house flags of the Union Sulphur Company, which consists of a red devil on a brimstone yellow background. These six flags, each supported by a parachute, gracefully descended to the waters of the Hudson River.

The *Herman Frasch* is a vessel of 7,000 tons deadweight carrying capacity, 371 feet length, 51 feet 9 inches breadth, and 32 feet 6 inches depth. Sloping topside water ballast tanks all fore and aft alongside of vessel makes the cargo holds self trimming and permits the cargo holds to be free from all obstructions thus allowing the vessel to be loaded by chutes in a remarkably short space of time. The second unusual feature in the construction of this vessel is the arrangement of machinery in which the high and low pressure Parsons turbines are each located close to the sides of ship and as far outboard as possible. This permits hopper shaped holds aft of the machinery space which may be unloaded by large grab buckets and therefore eliminates the obstruction from the shaft tunnels found in the ordinary design of vessel.

THE MATTER WITH AMERICA

The Forum, Fargo, N. D.

What's the matter with America these days?
Too many diamonds, not enough alarm clocks.
Too many silk shirts, not enough blue flannel ones.
Too many pointed-toed shoes, and not enough square-toed ones.
Too many serge suits and not enough overalls.
Too much décolleté and not enough aprons.
Too many satin upholstered limousines and not enough cows.
Too many consumers and not enough producers.
Too much oil stocks and not enough savings accounts.
Too much envy of the results of hard work and too little desire to emulate it.
Too many desiring short cuts to wealth and too few willing to pay the price.
Too much of the spirit of "Get while the getting is good" and not enough of the old fashioned Christianity.
Too much discontent that vents itself in mere complaining and too little real effort to remedy conditions.
Too much class consciousness and too little common democracy and love of humanity.

Investigations have been conducted in England upon the action of carbonic acid (CO_2) in lowering the temperature obtained upon the explosion of gas mixtures containing it. A mixture of 15 per cent. of coal gas and 85 per cent. of air develops a temperature of 2,400° C.; but a mixture of 15 per cent. of coal gas, 26.4 of oxygen and 58.6 of CO_2 gives only 1720° C., while a mixture of 15 per cent. of coal gas, 19.7 of oxygen and 65.3 of CO_2 gives 1340° C. The fall in the temperature is out of proportion to the specific heat of the CO_2, considered as a diluent; and it is attributed it, in part, to a break-up of the CO_2 itself.

Index to Advertisers

Announcement of Technical Books

COMPRESSED AIR DATA, by William Lawrence Saunders and Charles Austin Hirschberg.

Price, Domestic, $3.00 Net, Postage Paid.

COMPRESSED AIR PRACTICE, by Frank Richards, Technical Editor of Compressed Air Magazine.

Price, $3.00 Net, Postage Paid

COMPRESSED AIR FOR THE METAL WORKER, by Charles Austin Hirschberg.

Price $3.50 Net, Postage Paid

FLOW AND MEASUREMENT OF AIR AND GASES, by Alec B. Eason, M. A., Associate Member of the British Institute of Electrical Engineers

This book, just issued, is one of the most valuable compressed air technical books issued in years. It is an indispensable engineering work for those delving deeply into the subject, quoting 250 authorities.

252 Pages, with charts and equations. Price $7.50, postage paid.

ROCK DRILLING, OPEN CUT EXCAVATION AND SUBMARINE ROCK REMOVAL, by R. T. Dana and W. L. Saunders.

Practical data from reliable sources. Tells of work actually done and the means and methods employed. Blasting, explosives and the rock drill in all its relations.

319 Pages 6x9, Tables and Illustrations. $4.00 Net, Postage Prepaid.

COMPRESSED AIR PLANTS, by Robert Peele.

A thoroughly practical book with full information gathered from actual work in all lines and formulas, rules and tables for the necessary computation.

518 Pages 6x9, 209 Illustrations. $4.50, Postage Prepaid.

COMPRESSED AIR THEORY AND COMPUTATION, by Prof. Elmo G. Harris.

An authorative work that has been especially useful because of the charts, tables and clear, concise discussion of fundamental theory.

The second edition represents a thorough revision and an enlargement, consisting of a new chapter on "Centrifugal Fans and Turbine Compressors;" also an appendix on the Design of Logarithmic Charts.

192 Pages 6x9, Illustrated, $2.00.

PRACTICAL APPLIED ELECTRICITY, by Prof. Moreton.

Air workers must know much about electricity, and there is no book from which all the essentials can be so readily and so completely obtained as this.

440 Pages 7x4½, 430 Illustrations. $2.00 net, Postage Prepaid.

AIR COMPRESSION AND TRANSMISSION, by H. J. Thoekelson.

Contains clear, simple explanations of the thermodynamic phenomena involved. Of value to Designers, Consulting Engineers, Factory Superintendents and Operating Engineers.

207 Pages 6x9, 143 Illustrations. $2.60 (3-4), Postage Prepaid.

THE SUBWAYS AND TUNNELS OF NEW YORK, by Gilbert-Wightman and Saunders.

It is absolutely true that the cost of these works, built and building, is greater than that of the Panama Canal and this book tells about them.

$5.00 net, Postage prepaid.

AMERICAN CIVIL ENGINEERS' HANDBOOK, by Mansfield Merriman, Editor-in-Chief, and a Staff of Experts.

Fourth Edition, Just Published, 1955 Pages. Price $6.00.

HANDBOOK OF COST DATA, by Halbert P. Gillette.

Gives methods of construction and detailed actual costs of material and labor on all kinds of engineering work.

1900 Pages, numerous Tables and Illustrations, $6.00.

HANDBOOK OF ROCK EXCAVATION, by Halbert P. Gillette.

An eminently practical work covering fully and completely the drilling, excavating, quarrying and handling of rock.

840 Pages, 184 Illustrations, 87 Tables, $5.00.

CONCRETE CONSTRUCTION METHODS AND COSTS, by Halbert P. Gillette and Chas. S. Hill.

Treats of concrete and reinforced concrete structures of all kinds, giving working details and full data of costs.

700 Pages, 300 Illustrations, $5.00.

CIVIL ENGINEERS' POCKET BOOK, by Albert L. Frye.

An encyclopedia of engineering and necessary labor saver in all planning and estimating.

1600 Pages, numerous Illustrations and innumerable Tables, $5.00.

MECHANICAL AND ELECTRICAL COST DATA, by Gillette and Dana.

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